



CH2MHILL

CH2M HILL
1748 West Truck Road
Otis ANGB, MA 02542

21 September 2011

Mr. Jonathan S. Davis
Remediation Program Manager
HQ AFCEE/MMR
322 East Inner Road
Otis ANG Base, MA 02542-5028

SUBJECT: AFCEE FA8903-08-D-8769-0244; Task Order 0244
MMR SPEIM/LTM/O&M Program
CDRL #A001j
**Final Explanation of Significant Differences for the Installation Restoration
Program Groundwater Plumes at the Massachusetts Military Reservation**

Dear Mr. Davis:

As directed by the Air Force Center for Engineering and the Environment, CH2M HILL is hereby distributing copies of the *Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation* dated September 2011. Enclosed are three bound copies, one unbound copy and three compact disc (CD) copies. Copies are also being sent to the appropriate agencies.

If you have any questions or comments, please contact Mr. Jonathan Davis at (508) 968-4670, extension 4952.

Sincerely,

CH2M HILL

Patricia de Groot, P.G.
Program Manager

Enclosures: (3 bound, 1 unbound & 3 CDs)

- | | |
|---|--|
| <ul style="list-style-type: none">c. Rose Forbes, AFCEE/MMR (1 CD)Leticia Walton, 772d ESS/PKJ (1 w/o attach.)Bob Lim, EPA (1 bound, 1 CD)Lynne Jennings, EPA (2 bound, 1 CD)ORR Records & Information, EPA (1 CD)Peter Golonka, GF (1 bound, 1 CD)Leonard Pinaud, MassDEP (1 bound, 1 CD)Elliot Jacobs, MassDEP (1 bound, 1 CD) | <ul style="list-style-type: none">Dr. Mike Ciaranca, E&RC (1 CD)Jeanethe Falvey, EPA (1 w/o attach.)Ellie Donovan, MassDEP (1 w/o attach.)Rachel Marino, USCG (1 CD)Elizabeth Kirkpatrick, USCG (1 CD)Dr. Elizabeth Yu, U.S. Department of Justice (1 CD)CH2M HILL Document Control & Distribution |
|---|--|

Massachusetts Military Reservation



Final
Explanation of Significant Differences
for the Installation Restoration Program
Groundwater Plumes at the
Massachusetts Military Reservation

September 2011

Prepared for:
AFCEE/MMR
Installation Restoration Program
322 E. Inner Road
Otis ANGB, MA 02542

Prepared by:
CH2M HILL
1748 West Truck Road
Otis ANGB, MA 02542

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	iii
1.0 INTRODUCTION	1-1
1.1 STATEMENT OF PURPOSE.....	1-2
1.2 AUTHORIZING SIGNATURES.....	1-3
2.0 SITE HISTORY, SITE CONTAMINATION, AND SELECTED REMEDY	2-1
2.1 INSTALLATION LOCATION AND HISTORY	2-1
2.2 SITE-SPECIFIC SUMMARIES OF SITE HISTORY, CONTAMINATION, AND REMEDIAL ACTIONS	2-2
2.2.1 Ashumet Valley	2-2
2.2.2 CS-4	2-4
2.2.3 CS-10	2-5
2.2.4 CS-19	2-7
2.2.5 CS-20	2-7
2.2.6 CS-21	2-8
2.2.7 CS-23	2-8
2.2.8 FS-1	2-9
2.2.9 FS-12.....	2-10
2.2.10 FS-13.....	2-11
2.2.11 FS-28.....	2-12
2.2.12 FS-29.....	2-13
2.2.13 LF-1.....	2-14
2.2.14 SD-5	2-16
2.3 EXISTING SELECTED REMEDIES	2-17
3.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES AND EXPECTED OUTCOMES	3-1
3.1 SIGNIFICANT DIFFERENCES FROM THE SELECTED REMEDIES.....	3-1
3.1.1 Revisions to RAOs.....	3-2
3.1.2 Revisions to the Phrasing of LUCs.....	3-2
3.1.3 Inclusion of Monitored Natural Attenuation.....	3-4
3.1.4 Base-Wide, Three-Step Process.....	3-7
3.2 EXPECTED OUTCOMES.....	3-12
4.0 STATUTORY DETERMINATION.....	4-1

TABLE OF CONTENTS

5.0 STATE AGENCY COMMENTS AND PUBLIC PARTICIPATION ACTIVITIES	5-1
5.1 CONCURRENCE FROM THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION	5-1
5.2 PUBLIC PARTICIPATION ACTIVITIES	5-1
6.0 REFERENCES	6-1

Figures

<u>Figure 1-1</u>	Massachusetts Military Reservation, Cape Cod, Massachusetts
<u>Figure 1-2</u>	IRP Groundwater Plumes, Massachusetts Military Reservation – October 2010
<u>Figure 2-1</u>	Historic Delineation of the SD-5 Groundwater Plume – 2005
<u>Figure 2-2</u>	Historic Delineation of the FS-13 Groundwater Plume – 2004
<u>Figure 3-1</u>	IRP Plumes, Treatment Systems and Land Use Control Areas – October 2010
<u>Figure 3-2</u>	IRP Plumes, Treatment Systems and Remedial Technology Designation

Tables

<u>Table 1-1</u>	Summary of ROD Submittals for MMR Sites Subject to ESD
<u>Table 3-1</u>	Summary of Main Changes included in ESD
<u>Table 3-2</u>	Summary of Changes to RAOs
<u>Table 3-3</u>	Updated RAOs

Appendices

<u>Appendix A</u>	Selected Remedies as Originally Described in the Final RODs for the Following Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation: Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5
<u>Appendix B</u>	MassDEP Concurrence Letter

ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Engineering and the Environment
ARAR	applicable or relevant and appropriate requirement
BOH	Board of Health
BRL	below the reporting limit
CCl ₄	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COC	contaminant of concern
CS	Chemical Spill
DERP	Defense Environmental Restoration Program
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ETD	extraction, treatment, and discharge
ETI	extraction, treatment, and infiltration
ETR	extraction, treatment, and reinjection
FFA	Federal Facility Agreement
FS	Fuel Spill
FTA-1	firefighter training area 1
GAC	granular activated carbon
gpm	gallons per minute
GW-1	Groundwater-1

ACRONYMS AND ABBREVIATIONS

HATF	Hunter Avenue Treatment Facility
HI	hazard index
IRP	Installation Restoration Program
lbs	pounds
LF	Landfill
LUCs	Land Use Controls
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCP	Massachusetts Contingency Plan
MMCL	Massachusetts Maximum Contaminant Level
MMR	Massachusetts Military Reservation
MMRCT	MMR Cleanup Team
MNA	Monitored Natural Attenuation
NA	Natural Attenuation
NCP	National Contingency Plan
NPL	National Priorities List
PCE	tetrachloroethene
RAO	Remedial Action Objectives
RA-O	Remedial Action – Operation
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD	Record of Decision
SD	Storm Drain
SD-5N	Storm Drain-5 North
SD-5S	Storm Drain-5 South

ACRONYMS AND ABBREVIATIONS

SITM	Site Inspection Technical Memorandum
SRTF	Sandwich Road Treatment Facility
SSI	Supplemental Site Inspection
SVE	soil vapor extraction
SWOU	Southwest Operable Unit
SWP	shallow wellpoint
TCE	trichloroethene
USAF	U.S. Air Force
VC	vinyl chloride
µg/L	micrograms per liter
1,1,2,2-TeCA	1,1,2,2-tetrachloroethane
1,2,4-TMB	1,2,4-trimethylbenzene
1,3,5-TMB	1,3,5-trimethylbenzene
1,4-DCB	1,4-dichlorobenzene

1.0 INTRODUCTION

This Explanation of Significant Differences (ESD) has been prepared to document changes to the selected remedies for the following Installation Restoration Program (IRP) sites: Ashumet Valley, Chemical Spill (CS)-4, CS-10, CS-19, CS-20, CS-21, CS-23, Fuel Spill (FS)-1, FS-12, FS-13, FS-28, FS-29, Landfill (LF)-1, and Storm Drain (SD)-5. These IRP sites are all contaminated groundwater plumes associated with the Massachusetts Military Reservation (MMR), located on Cape Cod, Massachusetts ([Figures 1-1](#) and [1-2](#)). The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) number for the MMR site is MA2570024487.

In accordance with Executive Order 12580, the U.S. Air Force (USAF) is the lead agency for remedial actions at the MMR and this document is being issued by the USAF as the lead agency. The MMR was formally added to the NPL in 1989. A Federal Facilities Agreement (FFA), which provided the legal framework for investigating and remediating numerous operable units at the MMR, was signed in 1991 (EPA et al. 1991). In 1996, the FFA was amended to add the USAF as the lead agency for the cleanup at MMR (EPA et al. 2002). The FFA, as amended, requires the USAF to implement Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements at MMR. In addition to the USAF, the U.S. Environmental Protection Agency (EPA) and National Guard Bureau are parties to the FFA for the MMR. The Air Force Center for Engineering and the Environment (AFCEE) is managing the groundwater sites subject to this ESD under the IRP in accordance with CERCLA as required by the Defense Environmental Restoration Program (DERP). The Massachusetts Department of Environmental Protection (MassDEP) is not a signatory of the FFA, but is an active participant in the clean-up process and provides guidance and direction to the process through several chartered boards and committees. The USAF and EPA have jointly selected the remedies for these sites. The MassDEP concurs with the selected remedies.

The Records of Decision (RODs) that prescribe the final remedies for these sites are summarized in [Table 1-1](#). These RODs were developed over an approximate 10-year period. During that time, refinements and revisions were made to the language used in each of the

RODs at MMR based on discussions and negotiations with stakeholders and legal counsel. These refinements are generally recognized as providing more descriptive clarity to the remedies described in each ROD. The differences in the remedial or enforcement action, settlement, or consent decree presented in this ESD significantly change but do not fundamentally alter the remedy selected in each ROD with respect to scope, performance, or cost. In order to apply these refinements consistently to all potentially affected RODs, the most current language is being incorporated into each of the RODs listed in [Table 1-1](#) as part of this ESD. In general, the subject changes can be designated into four different groupings as follows:

1. Revisions to the phrasing of Remedial Action Objectives (RAOs);
2. Revisions to the phrasing of Land Use Controls (LUCs);
3. Clarifying the inclusion of Monitored Natural Attenuation (MNA) as a component of selected remedies; and
4. Adding and revising text regarding the MMR Three-Step Process for each site which describes the anticipated steps that will need to be completed to achieve site closure.

While at least one of the grouping changes summarized above will apply to each of the RODs, not all of the grouping changes will apply to every ROD. ROD-specific applicability of each of the grouping changes is described in detail in Section 3.0 of this ESD.

1.1 STATEMENT OF PURPOSE

AFCEE is issuing this ESD in accordance with §117(c) of CERCLA and 40 Code of Federal Regulations (CFR) Section 300.435(c) of the National Contingency Plan (NCP) which requires the publication of an ESD to describe the significant difference(s) between the selected remedial action and the modified remedial action, including an explanation of why such changes were made. As required by Section 300.825(a)(2) of the NCP, this ESD will become part of the Administrative Record for IRP Sites: Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5 at the MMR. The Administrative Record is available for public review at the AFCEE IRP Office (322 East Inner Road, Otis ANG Base, Massachusetts, 02542) Monday - Friday, 8 a.m. to 4 p.m., excluding federal and state holidays. The Administrative Record is also available for public review at www.mmr.org.

1.2 AUTHORIZING SIGNATURES

The following signatures represent the decision to authorize this ESD.

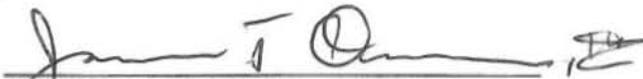
U.S. AIR FORCE



HARRY E. FINKE, P.E., GS-15
Civilian Deputy Director
Air Force Center for Engineering and the Environment

Date: 30 AUG 2011

U.S. ENVIRONMENTAL PROTECTION AGENCY



JAMES T. OWENS III
Director
Office of Site Remediation and Restoration

Date: 9/14/11

2.0 SITE HISTORY, SITE CONTAMINATION, AND SELECTED REMEDY

This section presents background information on the IRP sites Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5, including an overview of the physical and chemical characteristics, history, and selected remedies for these plumes.

2.1 INSTALLATION LOCATION AND HISTORY

The groundwater contaminant plumes originated from releases from multiple sources related to various activities on the MMR. The activities included the storage, handling, and disposal of solvents and petroleum fuels. Landfill operations, firefighter training, sewage treatment, and numerous chemical and fuel spills and leaks have also resulted in groundwater contamination. The MMR, listed on the National Priorities List (NPL) as Otis Air National Guard/Camp Edwards, is located on upper Cape Cod, Massachusetts ([Figure 1-1](#)). IRP sites Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5 are located within the MMR and/or off-base within the surrounding towns of Bourne, Falmouth, Mashpee, and Sandwich, Massachusetts ([Figure 1-2](#)). The groundwater plumes associated with IRP Sites SD-5 and FS-13 have largely attenuated, cannot be defined as contiguous plumes, and are therefore no longer depicted on IRP figures. However, the historical delineation of these two plumes when last depicted are shown in [Figures 2-1](#) and [2-2](#), respectively.

The MMR comprises approximately 22,000 acres on Cape Cod and provides facilities for several operating command units: the Air National Guard, the Army National Guard, the USAF, the U.S. Coast Guard, and the Veterans Affairs. Past military training, maneuvers, and aircraft operations, maintenance and support activities at the MMR have resulted in releases of hazardous materials that generated plumes of contaminated groundwater in the unconfined sand and gravel aquifer that underlies the MMR and the surrounding towns.

2.2 SITE-SPECIFIC SUMMARIES OF SITE HISTORY, CONTAMINATION, AND REMEDIAL ACTIONS

For each IRP Site/Plume, the following subsections include brief summaries of where the plume came from, the current status of the source area, and the current status of the plume and remedial actions. The locations of the plumes are shown on [Figures 1-2, 2-1, and 2-2](#). The information used to generate these summaries was from the RODs ([Table 1-1](#)), the *Final 3rd Five Year Review, 2002-2007 Massachusetts Military Reservation Superfund Site* (AFCEE 2008a), the primary site documents available in the Administrative Record and on the MMR IRP website at <http://www.mmr.org/primarydocs/primarydocs.html> and the *2010 Groundwater Plume Maps and Information Booklet* at http://mmr.org/cleanup/2010_booklet.html. For further details on the plumes addressed in this ESD, the reader should refer to the documents listed above.

2.2.1 Ashumet Valley

Sources of this plume have been identified as the former fire training area-1 (FTA-1) and the former MMR Sewage Treatment Plant (CS-16 and CS-17). Fire training exercises were held from 1958 to 1985 at FTA-1, during which time flammable waste liquids were burned and extinguished. The former sewage treatment plant, which operated from 1936 to 1995, released treated water to a series of sand infiltration beds. De-watered sewage sludge was disposed of in a nearby wooded area. The predominant contaminants of concern (COCs) in the Ashumet Valley groundwater plume are tetrachloroethene (PCE) and trichloroethene (TCE). Maximum concentrations of PCE and TCE detected in 2009 in the Ashumet Valley plume were 43 micrograms per liter ($\mu\text{g/L}$) and 12 $\mu\text{g/L}$, respectively. The state and federal Maximum Contaminant Level (MCL) for both PCE and TCE is 5 $\mu\text{g/L}$. In addition to PCE and TCE, thallium and manganese are also COCs at Ashumet Valley with cleanup goals of 300 $\mu\text{g/L}$ for manganese (EPA Health Advisory) and the MCL of 2 $\mu\text{g/L}$ for thallium. Detections of these compounds above cleanup goals are limited to an area to the west of Ashumet Pond and are expected to decrease to concentrations below cleanup goals without active treatment.

Treatment of contaminated soils at FTA-1 began in June 1995 and was completed in September 1997. A total of 42,531 tons of soil were treated using a thermal treatment process at MMR. In 2001 and 2002, more than 6,000 tons of contaminated soil, including the de-watered sludge, were removed from the CS-16 and CS-17 sites and taken off-base for proper disposal.

The Ashumet Valley remedial system consists of: (1) an extraction, treatment, and infiltration (ETI) remedial system; and (2) a leading edge extraction, treatment, and discharge (ETD) remedial system. The Ashumet Valley plume is currently in remedial action-operation (RA-O) status through the operation of these two groundwater remedial systems and associated plume monitoring. The ETI system was installed as part of an interim remedy and was supplemented with the ETD system as part of the final remedy as specified in the 2009 ROD.

The Ashumet Valley ETI system began operation on 22 November 1999 at a total system flow rate of 1,200 gallons per minute (gpm) with three extraction wells, two treatment plants, and two infiltration trenches. The extraction wells are located along the axis of the plume and the two infiltration trenches are aligned parallel to the long axis of the plume. On 18 May 2007, the ETI system was optimized and the operation of the two northernmost extraction wells was discontinued, as these two wells had substantially remediated the aquifer within their capture zones. The ETI system currently operates with one extraction well processing 350 gpm through one of the two treatment plants. On 24 August 2009, a new leading edge ETD system began operation that is designed to remove contaminant mass at the leading edge of the plume rather than full hydraulic capture of the southern portion of the plume. The ETD system consists of an extraction well pumping at 175 gpm, a mobile treatment unit housing a granular activated carbon (GAC) system, and a discharge bubbler that returns treated water to the Backus River. In total, the Ashumet Valley ETI and ETD systems are currently treating 525 gpm of contaminated groundwater.

Studies have shown that a portion of the Ashumet Valley plume discharged to Ashumet Pond in the past but current monitoring data indicate that the PCE and TCE concentrations in the plume near Ashumet Pond have declined to levels below MCLs. Additionally, no plume contaminants were detected in Ashumet Pond surface water when sampled in April 2010. A part of the southern portion of the Ashumet Valley plume discharges to the Backus River in Falmouth. Although past detections of PCE in Backus River surface water have been slightly above 5 µg/L, in the most recent surface water sampling round conducted in May 2010, both PCE and TCE concentrations were well below 5 µg/L.

2.2.2 CS-4

The source of the CS-4 groundwater plume was a vehicle maintenance area and storage yard that was used from 1940 to 1983. The area included a former gasoline station, a former bus terminal, a suspected waste disposal pit, and piles of sand and debris. The COCs in the CS-4 plume are PCE, TCE, 1,1,2,2-tetrachloroethane (1,1,2,2-TeCA), and ethylene dibromide (EDB). The maximum concentrations of the COCs in the CS-4 plume in 2009 were as follows: PCE (23.2 µg/L), TCE (5.5 µg/L), 1,1,2,2-TeCA (2.4 µg/L), and EDB (below the reporting limit [BRL] of 0.01 µg/L). The MCL for PCE and TCE is 5 µg/L, the Massachusetts Contingency Plan (MCP) Groundwater-1 (GW-1) standard for 1,1,2,2-TeCA is 2 µg/L, and the Massachusetts MCL (MMCL) for EDB is 0.02 µg/L.

In 1994, more than 13,000 tons of contaminated soil at the CS-4 site were treated using an on-site thermal treatment unit. In 2001, an additional 5,200 tons of contaminated soils, along with an old underground storage tank, were excavated from the site. The soil was transported off-site for disposal at a state-permitted landfill.

In November 1993, operation of a treatment system to address the groundwater contamination began. In February 2000, a ROD was signed that called for more effective extraction wells to be constructed for CS-4. In May 2003, AFCEE, with concurrence from EPA and MassDEP, turned off the original CS-4 treatment system because of its

inefficiency. The original CS-4 system consisted of 13 extraction wells (pumping at a combined flow rate of 120 gpm), a treatment plant, and two infiltration trenches. The improved treatment system, which became operational in November 2005, consisted of three extraction wells operating at a combined flow of 620 gpm with treatment through GAC at the Hunter Avenue Treatment Facility (HATF). The system currently consists of two extraction wells operating at a combined flow rate of 170 gpm. The third CS-4 extraction well was shutdown in December 2009 as a result of an optimization evaluation. The CS-4 plume is currently in RA-O status through the operation of the remedial system and associated plume monitoring.

2.2.3 CS-10

The primary sources of the CS-10 groundwater plume are spills and releases that occurred during the operation of the former Boeing Michigan Aerospace Research Center Missile Site (from 1960 to 1973) and Unit Training Equipment Site (in operation since 1978). Other sources at MMR likely contributed to the CS-10 plume. The COCs in the CS-10 plume are PCE and TCE. In 2009, the maximum concentrations for PCE and TCE in the CS-10 plume monitoring network were 36 µg/L and 1,740 µg/L, respectively; however, TCE concentrations approaching 4,000 µg/L have been detected during an ongoing (2010) data gap investigation. The state and federal MCL for PCE and TCE is 5 µg/L.

In 1996, fifteen drainage structures in the source areas were removed as part of the base-wide Drainage Structure Removal Program. In November 1998, a source area ROD was signed, which specified cleanup actions using both soil vapor extraction (SVE) and excavation and off-site disposal of contaminated soils and an underground storage tank. In 2001, more than 1,500 tons of contaminated soil were excavated and taken off-site for disposal. The SVE system was started in February 2002 and operated through April 2005, removing more than 5.4 pounds (lbs) of VOCs from the soils.

Three treatment systems were designed and installed to remediate the CS-10 plume: (1) the CS-10 In-Plume ETI system; (2) the CS-10 Sandwich Road extraction, treatment, and reinjection (ETR) system; and (3) the CS-10 Northern lobe extraction well. The In-Plume system currently uses eight extraction wells. This system started in June 1999 with five extraction wells originally treating 1,920 gpm; three extraction wells were added in April 2000 increasing the total original design flow rate to 2,700 gpm; and a ninth extraction well was added in October 2004; one extraction well was shutdown in February 2010 as a result of an optimization evaluation. The extracted groundwater is treated through GAC at the CS-10 In-Plume treatment plants and reinjected through two infiltration trenches and one reinjection well, which was added in 2009. The CS-10 In-Plume system is currently operating at a total flow rate of 2,290 gpm. The Sandwich Road system came online in May 1999 at a total flow rate of 820 gpm using eight extraction wells. A new well was added to the Sandwich Road system to address contamination in the southern trench area in 2009. The Sandwich Road extraction fence (currently with five operating extraction wells) and the new extraction well currently operate at a total flow rate of 700 gpm. Extracted water is treated through GAC at the Sandwich Road Treatment Facility (SRTF) and reinjected through the three eastern Sandwich Road reinjection wells and the eight SD-5 North reinjection wells. The single extraction well Northern Lobe system began operation in January 2000 at a flow rate of 75 gpm; at present, the Northern Lobe extraction well operates at 190 gpm, and the extracted water is treated through GAC at the SRTF. The other two CS-10 leading edge plume lobes (Southern Lobe, North Central Lobe) are expected to naturally attenuate without active treatment and are being monitored. The CS-10 plume is currently in RA-O status through the operation of the CS-10 remedial systems and associated plume monitoring.

Studies have shown that portions of the CS-10 plume discharged to Ashumet Pond and Johns Pond in the past but current monitoring data indicate this is no longer occurring; no plume contaminants were detected in surface water sampled from these ponds in April 2010.

2.2.4 CS-19

The primary source of contamination at CS-19 is ordnance and military waste disposal. An area of approximately two acres was used to bury and detonate ordnance and munitions debris at depths to approximately 12 feet. These ordnance and waste disposal practices at the CS-19 source area resulted in contaminants being released to the surrounding soil and groundwater. The COC in the CS-19 plume is hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). In 2009, the maximum concentration of RDX in the CS-19 plume was 10 µg/L. The clean up level for RDX in groundwater at CS-19 is the EPA-derived risk-based level of 0.6 µg/L.

AFCEE conducted multiple testing and cleanup actions at the CS-19 source area between 2004 and 2009, including the removal of more than 2,800 cubic yards of soil, 8,500 ordnance items, and 27,000 lbs of munitions debris from the original two-acre site.

The selected remedy for the CS-19 plume is MNA with LUCs as specified in the 2009 ROD. A groundwater monitoring program is currently underway at CS-19 to verify the natural attenuation (NA) of the groundwater contamination.

2.2.5 CS-20

The CS-20 plume was first detected in 1997 during the FS-28 remedial investigation. The specific source of the CS-20 plume has not been identified. The plume most likely originated somewhere in the southern portion of MMR, which contained various aircraft and vehicle maintenance shops, runways, and housing/personnel support facilities. Records indicate that spills and/or releases occurred in these areas in the past. The COC in the CS-20 plume is PCE. The maximum PCE concentration in the CS-20 plume in 2009 was 20.5 µg/L. The state and federal MCL for PCE is 5 µg/L.

The CS-20 plume is currently in RA-O status through groundwater extraction and treatment and associated plume monitoring. In January 2006, two CS-20 extraction wells became operational at a total flow rate of 775 gpm with treatment through GAC at the

HATF. The two CS-20 extraction wells are currently pumping at a combined flow rate of 749 gpm.

Due to difficulties achieving access to an acceptable location to site the originally-designed third CS-20 extraction well, AFCEE decided to forego its construction and perform monitoring in this uncaptured leading edge area. An ESD for CS-20 was issued in September 2008 to document the final design of the treatment system (in-plume) which includes natural attenuation of the leading edge uncaptured portion of the plume as part of the final remedy.

2.2.6 CS-21

The CS-21 plume was first detected in 1998 during an investigation of an area southwest of MMR. Similar to CS-20 above, the specific source of CS-21 has not been identified and most likely originated somewhere in the southern portion of MMR. The COC in the CS-21 plume is TCE. The maximum TCE concentration in the CS-21 plume in 2009 was 98 µg/L. The state and federal MCL for TCE is 5 µg/L.

The CS-21 plume is currently in RA-O status through groundwater extraction and treatment and associated plume monitoring. In September 2006, four CS-21 extraction wells became operational at a total flow rate of 1,400 gpm with treatment through GAC at the HATF. In June 2010, the westernmost extraction well was shutdown when contaminant levels in the leading edge of the plume decreased below the MCL. The three remaining CS-21 wells operate at a combined flow rate of 1,048 gpm.

2.2.7 CS-23

Evidence of the CS-23 plume was found in 2002 after routine sampling indicated the presence of groundwater contamination in an area between the CS-10, CS-21, and LF-1 groundwater plumes, located in the southwest portion of MMR. The CS-23 plume is a detached plume and has not been linked to a specific source area. The COCs in the CS-23 plume are TCE and carbon tetrachloride (CCl₄). The maximum concentrations of

TCE and CCl₄ in the CS-23 plume in 2009 were 17.7 µg/L and 2.3 µg/L, respectively. The state and federal MCL for TCE and CCl₄ is 5 µg/L.

The CS-23 plume is currently in RA-O status through groundwater extraction and treatment and associated plume monitoring. Two extraction wells were installed in 2006 to remediate the CS-23 plume. The two CS-23 extraction wells are currently operating at 700 gpm. The contaminated groundwater from these extraction wells, which came online in December 2006, is combined with groundwater extracted from two LF-1 wells and treated through GAC at the HATF.

2.2.8 FS-1

The source of the FS-1 groundwater plume is the Aviation Gas Fuel Valve Test Dump Site in the eastern part of the base near the runways and within the flight line. The site was used from 1955 to 1970 to test fuel dump valves on EC-121 Super Constellation aircraft. As part of the tests, fuel was released directly onto the ground. The FS-1 plume is comprised of two areas of concern: the source area groundwater, which is located on-base and is limited to an area within 1,000 feet of the runways; and a detached groundwater plume, which is located off-base. The COCs for the source area groundwater are toluene, thallium and lead while the COC for the detached groundwater plume is EDB. The maximum concentration of EDB in the FS-1 plume in 2009 was 0.857 µg/L. The MMCL for EDB is 0.02 µg/L. The source area groundwater is no longer sampled for toluene or thallium because these analytes are either below their respective cleanup levels or have not been detected. When last sampled in June 2009, the maximum total lead concentration near the FS-1 source area in groundwater was 30.7 µg/L. The clean up level for lead at FS-1 is 15 µg/L, which is an EPA treatment technique action level for lead in drinking water systems.

No significant concentrations of contaminants were present in the surface or subsurface soils at the FS-1 source area. The FS-1 ROD, signed in April 2000, stated that since soils at the FS-1 source area would not cause continuing degradation of groundwater, no

further action was needed, although periodic monitoring of source area groundwater for lead continues as noted above.

The FS-1 EDB plume is currently in RA-O status through groundwater extraction and treatment and associated plume monitoring. In April 1999, AFCEE installed a treatment system consisting of a treatment plant, a deep extraction well, and a series of 175 shallow wellpoints (SWPs) in the Quashnet River cranberry bog area. The system was designed to operate at 750 gpm with the objective of remediating the plume and preventing upwelling of EDB contamination into the Quashnet River and associated cranberry bogs. In April 2000, the ROD was issued formalizing the need for groundwater treatment. In October 2002, a fire destroyed the treatment plant. A new treatment system was constructed and became operational in October 2003 at a total system flow rate of 750 gpm. The new system included a rebuilt treatment plant and four extraction wells and discontinued the use of the SWPs. It was acknowledged that a small portion of the FS-1 EDB plume near the Quashnet River cranberry bog area would remain uncaptured and discharge to surface water. In 2007, the system was optimized and one of the extraction wells was turned off due to a reduction of the plume size. The system currently treats 515 gpm via a GAC treatment process.

Due to the discharge of the downgradient uncaptured portion of the FS-1 plume, sporadic detections of EDB are still reported in surface water based on data collected in 2009. However, no EDB was detected in the most recent round of surface water sampling conducted at the Quashnet River and bogs in May 2010.

2.2.9 FS-12

The source of the FS-12 groundwater plume was a series of releases from approximately 1969-1970 from a section of now-abandoned fuel pipeline that ran from the Cape Cod Canal to MMR. The pipeline carried aviation gasoline and jet fuel. The COCs in the FS-12 plume are benzene and EDB. In 2009, the maximum concentrations for benzene and EDB in the FS-12 plume were 1.1 µg/L and 23.1 µg/L, respectively. The state and federal MCL for benzene is 5 µg/L. The MMCL for EDB is 0.02 µg/L.

Groundwater near the source area is currently being monitored after undergoing subsurface remediation in the 1990s. Current groundwater sampling indicates that some residual levels of fuel-related compounds still remain in the shallow groundwater beneath the source area, but not enough to sustain a groundwater plume. The pipeline has been cleaned and closed with state and federal regulatory approval. Groundwater concentrations in monitoring wells located in the source area no longer exceed MCLs/MMCLs and thus the plume is not delineated in the source area.

The FS-12 plume is currently in RA-O status through operation of the FS-12 remedial system and associated plume monitoring. In September 1997, AFCEE began operation of a treatment system to remediate the groundwater contamination. At the time of startup, the FS-12 ETR system operated at a combined flow rate of 772 gpm through extraction of contaminated groundwater from a total of 25 extraction wells and a GAC treatment process. The treated water was then returned to the aquifer through 22 reinjection wells. As a result of optimizations, the FS-12 treatment system currently operates using four extraction wells and 20 reinjection wells at a total flow rate of 360 gpm.

2.2.10 FS-13

The FS-13 plume ([Figure 2-1](#)) is located on-base within the footprint of CS-10 plume, although it is shallower in the aquifer with contamination near the water table. The source of the FS-13 plume was a fuel spill that is believed to have occurred in 1972 near the rotary at the east end of Connery Avenue. The COCs for the FS-13 plume are 1,2,4-trimethylbenzene (1,2,4-TMB) and 1,3,5-trimethylbenzene (1,3,5-TMB). When last sampled in November 2004, the maximum concentrations of 1,2,4-TMB and 1,3,5-TMB in FS-13 groundwater were 383 µg/L, and 143 µg/L, respectively. There are no applicable drinking water standards for 1,2,4-TMB and 1,3,5-TMB; however, the calculated risk-based concentration, based on a hazard index equal to 1, for each COC is 17 µg/L.

A Site Inspection Technical Memorandum (SITM) was completed in 1996 and a Supplemental Site Inspection (SSI) was completed in 2006 for the FS-13 source area. No further action was recommended for the FS-13 source area based on the analysis of sampling data collected from the site characterization efforts of the 1996 SITM and 2006 SSI. A decision document was prepared to document the no further action decision for the FS-13 source area.

The 2000 ROD selected remedy for the FS-13 plume was Limited Action (consisting of long-term monitoring) and Institutional Controls. In October 2007, the FS-13 source area was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site. A Final ESD was submitted in September 2008, which updated the LUC language for FS-13. Long-term monitoring data collected at FS-13 indicate that the plume contaminants are not mobile and have not migrated. Therefore, routine groundwater monitoring of FS-13 is no longer conducted. AFCEE will perform a final round of monitoring in the future to demonstrate clean up goals have been met at FS-13.

2.2.11 FS-28

Portions of the FS-28 plume were first discovered in 1993 beneath the leading edge of the CS-4 plume. In 1996, groundwater investigations determined that EDB was upwelling into the Coonamessett River in Falmouth. The area between the upwelling in the river and the CS-4 leading edge was investigated and a separate groundwater plume (FS-28) was delineated in 1997. Similar to CS-20 and CS-21 above, the specific source of FS-28 has not been identified and most likely originated somewhere in the southern portion of MMR. The COC in the FS-28 plume is EDB. In 2009, the maximum EDB concentration in the FS-28 plume was 1.38 µg/L. The MMCL for EDB is 0.02 µg/L.

The FS-28 plume is currently in RA-O status through operation of the FS-28 remedial system and associated plume monitoring. In October 1997, AFCEE started operation of the FS-28 treatment system, which was designed to treat 750 gpm and consisted of one deep extraction well to capture the FS-28 plume and to prevent EDB from entering the

Coonamessett River. In April 1999, 204 SWPs were installed in a cranberry bog to augment the deep extraction well. These systems were installed under time-critical and non-time-critical actions that became the selected alternative in the final ROD for FS-28 in 2000. With regulatory concurrence, AFCEE permanently shut down the SWPs in February 2010 since it was concluded they were no longer effective in remediating the remaining residual EDB contamination in the immediate area of the SWPs. The NA of this part of the plume will be monitored.

In 2006, AFCEE further investigated the southern portion of the FS-28 plume and defined two previously uncharacterized lobes of EDB contamination. Based on the results of the investigation, AFCEE installed a second extraction well near the leading edge of the deeper Western Lobe. The new extraction well, which is piped to the existing FS-28 treatment plant, became operational in December 2007. The FS-28 remedial system is currently operating with two extraction wells at a total flow rate of 600 gpm with GAC treatment. AFCEE is monitoring the NA of the shallower lobe as well as the uncaptured downgradient portion of the deep lobe.

A portion of the FS-28 groundwater plume remains shallow in the aquifer near the Coonamessett River and bog network and is expected to discharge to surface water. However, surface water data indicate that no detectable levels of EDB have been present in the Coonamessett River since May 1999. EDB has been sporadically detected at concentrations below drinking water standards in surface water sampled from the bog ditches. EDB was not detected in any surface water samples collected in the Coonamessett River and bogs ditches when last sampled in May 2010.

2.2.12 FS-29

The FS-29 plume was first detected in 1998 during an investigation of an area southwest of MMR. Similar to CS-20, CS-21, and FS-28 above, the specific source of FS-29 has not been identified and most likely originated somewhere in the southern portion of MMR. The COCs in the FS-29 plume are EDB and CCl₄. The maximum concentrations of EDB and CCl₄ in the FS-29 plume in 2009 were 0.084 µg/L and 5.5 µg/L,

respectively. The MMCL for EDB is 0.02 µg/L. The state and federal MCL for CCl₄ is 5 µg/L.

The FS-29 plume is in RA-O status through groundwater extraction and treatment and associated plume monitoring (although as described below, active treatment is not currently ongoing at FS-29). A ROD was signed in 2000 which specified design and construction of a treatment system to address the groundwater contamination associated with the FS-29 plume.

The FS-29 system came online in September 2006 and consisted of two extraction wells operating at an original combined flow rate of 525 gpm. The groundwater was pumped to the HATF for treatment through GAC. An optimization evaluation of the FS-29 treatment system was completed in April 2009 which resulted in the shutdown of one of the two FS-29 extraction wells (80EW0002). Additionally, the second FS-29 extraction well (80EW0001) was shutdown in September 2010 as a result of optimization. Therefore, no active treatment is currently (October 2010) being conducted at FS-29 and the plume is being monitored. If warranted based on review of the monitoring data, groundwater extraction and treatment may be resumed.

Due to very low concentrations, no active treatment was needed for the portion of the plume located downgradient of the two extraction wells. Monitoring of that area is being performed. An ESD for FS-29 was issued in September 2008 to document the final design of the treatment system which included NA of the leading edge of the plume as part of the final remedy.

2.2.13 LF-1

The source of the LF-1 groundwater plume was the main MMR landfill. From 1941 to 1989, disposal of solid waste occurred in this area. Disposal of wastes was discontinued at the landfill in 1990. The LF-1 plume extends from the landfill to approximately 18,000 feet to the west-southwest where the northern lobe discharges to Red Brook Harbor and the southern lobe discharges to Squeteague Harbor. The COCs for the LF-1

groundwater plume are PCE, TCE, CCl₄, vinyl chloride (VC), 1,1,2,2-TeCA, 1,4-dichlorobenzene (1,4-DCB), EDB, and manganese. The maximum concentrations for each of the COCs at LF-1 in 2009 was as follows: PCE (20.4 µg/L), TCE (37.0 µg/L), CCl₄ (17 µg/L), VC (5.8 µg/L), 1,1,2,2-TeCA (6.3 µg/L), 1,4-DCB (10.0 µg/L), EDB (0.017 µg/L), and manganese (360 µg/L). The MCL for PCE, TCE, and CCl₄ is 5 µg/L; the MMCL for 1,4-DCB is 5 µg/L. The MCL and GW-1 standard for VC and 1,1,2,2-TeCA, respectively, is 2 µg/L; the MMCL for EDB is 0.02 µg/L. The EPA Health Advisory for manganese is 300 µg/L.

Groundwater data collected from 1989 to present indicate that no significant contamination is being released to groundwater from the older landfill cells (1947, 1951, and 1957), referred to as the Northwest Operable Unit. The three more recently used cells (1970, Kettle Hole, and post-1970) were capped in December 1995. These actions were taken to reduce the amount of contaminants within the landfill cells from potentially being released to the groundwater. The landfill cover consists of an impermeable cap built on top of the cell, a drainage system, and 70 gas vents designed to release methane gas (from the breakdown of refuse) from the interior of the landfill. Gas probes are located around the perimeter of the capped cells to monitor subsurface vapors. Little to no methane is detected during periodic monitoring. Decreasing chemical concentrations in groundwater downgradient of the landfill suggest that the capping of the landfill cells has been effective in reducing the loading of contamination to groundwater at the source. The landfill cap is inspected annually.

The LF-1 plume is currently in RA-O status with a groundwater extraction and treatment system and associated plume monitoring. The final remedy for LF-1 is hydraulic capture of the plume at the MMR base boundary using the groundwater extraction and treatment system; and NA for the portion of the plume to the west of the MMR base boundary. The original LF-1 system design included five extraction wells, a treatment plant using a GAC treatment process, and an infiltration system. This system, which was designed to treat 700 gpm, operated for seven years from 1999 until mid-2006. In 2006, the design of a groundwater treatment system for the adjacent CS-23 plume involved an evaluation of

the southern portion of the LF-1 plume. Two extraction wells were installed to remediate the CS-23 plume and one to remediate the southern portion of the LF-1 plume. The contaminated groundwater from these three new extraction wells is treated at the HATF. In addition, one of the existing extraction wells from the original LF-1 system was diverted from the LF-1 treatment plant to the HATF to free up capacity at the LF-1 plant. Currently, the combined flow from the four LF-1 wells to the LF-1 treatment plant is 595 gpm. In 2006 it was discovered that the capacity of the LF-1 infiltration system was decreasing. As a result, a new reinjection well was installed adjacent to the LF-1 infiltration system to return treated water to the aquifer. The two other LF-1 wells that send water to HATF operate at 650 gpm. Therefore, a total of 1,245 gpm of LF-1 groundwater is currently being treated.

The western uncaptured portion of the LF-1 plume discharges to both Red Brook and Squeteague harbors. Surface water and discharging groundwater at the harbors are sampled annually and although sporadic detections of select COCs are reported, concentrations are sufficiently low that there are no unacceptable risks at these discharge points.

2.2.14 SD-5

The primary sources of the SD-5 groundwater plume were historical releases and runoff of chlorinated solvents and fuel constituents to storm drains from various military and industrial activities on the MMR. The SD-5 plume ([Figure 2-2](#)) is split into two parts, the north (SD-5N) and south (SD-5S). The COC in the SD-5N and SD-5S plume is TCE. The maximum TCE concentration at SD-5 when last sampled in November 2008 was 9.8 µg/L. The MCL for TCE is 5 µg/L.

Excavation of contaminated soils at the SD-5N source area began in April 2001. Almost 6,500 tons of soil were removed and taken off-site for proper disposal at a state-permitted landfill. In August 2002, an SVE system was installed at the site. Approximately 5 lbs of contaminants were removed by the SVE system which was shutdown in March 2003 with concurrence from the regulatory agencies.

In August 1997, AFCEE began operation of an ETR system to address the groundwater contamination at SD-5N. It contained a series of 10 extraction wells, a treatment plant and eight reinjection wells located at the base boundary. The ETR system operated at 355 gpm. In August 2003, AFCEE, with concurrence from the regulatory agencies, shut down the SD-5N treatment system.

In June 1999, AFCEE began operation of two recirculating wells in the main SD-5S plume body at a combined flow rate of 120 gpm. In January 2000, AFCEE installed an extraction well that operated at 100 gpm to capture additional contamination at SD-5S. In December 2000, AFCEE, with concurrence from the regulatory agencies, turned off one recirculating well because the groundwater in the vicinity was below clean up levels. In April 2003, the second recirculating well was shutdown and in February 2004 the SD-5S extraction well was shutdown.

Even though the treatment systems for this plume have been shutdown, AFCEE continues to monitor the NA of the remaining TCE in the SD-5 area which is the selected remedy as specified in the final ROD for SD-5. Past studies have shown that the SD-5S plume discharged to Johns Pond. However, no plume contaminants were detected in Johns Pond surface water when last sampled in April 2010.

2.3 EXISTING SELECTED REMEDIES

For the purpose of explaining the differences between the remedies that were identified in the RODs and the changes proposed by this ESD, the selected remedies as they were originally described in the Final RODs listed in [Table 1-1](#) are presented in [Appendix A](#). In order to avoid uncertainty, the remedy descriptions included in [Appendix A](#) were taken directly from the RODs listed in [Table 1-1](#). As such, the descriptions occasionally cite figures, appendices, references, etc. that are not included in the information presented in [Appendix A](#) in the interest of brevity. For complete access to cited materials such as figures, appendices, and references, the reader is directed to the original RODs ([Table 1-1](#)) which are available from the Administrative Record on www.mmr.org.

3.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES AND EXPECTED OUTCOMES

This section describes the differences between the selected remedies (as described in the RODs) for the Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5 Groundwater Plumes documented in this ESD and the expected outcomes of the changes to the original RODs. The following subsections describe the rationale for deviating from the selected remedies as they were originally described in the RODs.

3.1 SIGNIFICANT DIFFERENCES FROM THE SELECTED REMEDIES

These RODs were developed over an approximate 10-year period ([Table 1-1](#)). During that time, refinements and revisions were made to the language used in each of the RODs at MMR based on discussions and negotiations with stakeholders and legal counsel. These refinements are generally recognized as providing more descriptive clarity to the remedies described in each ROD. The differences in the remedial or enforcement action, settlement, or consent decree presented in this ESD significantly change but do not fundamentally alter the remedy selected in each ROD with respect to scope, performance, or cost. In order to apply these refinements consistently to all potentially affected RODs, the most current language, which is presented in detail in Sections 3.1.1 through 3.1.4, is being incorporated into each of the RODs ([Table 1-1](#)) as part of this ESD, where necessary. In general, the subject changes can be designated into four different groupings as follows:

1. Revisions to the phrasing of RAOs,
2. Revisions to the phrasing of LUCs,
3. Clarifying the inclusion of MNA as a component of selected remedies, and
4. Adding text regarding the base-wide, three-step process to achieve site closure.

While at least one of the grouping changes summarized above will apply to each of the subject site RODs, not all of the grouping changes will apply to every ROD. A matrix summarizing the main changes necessary for each site is included as [Table 3-1](#).

3.1.1 Revisions to RAOs

The wording of the RAOs that address controlling exposure to contaminated groundwater has evolved over time such that the use of terms such as “reduce” regarding exposure is no longer acceptable. Instead, exposure should be “prevented” (not “prevented or reduced”). Furthermore, the specific wording of these “exposure” RAOs has also evolved over time. Based on the most recent RODs prepared in 2009, the accepted wording for the RAOs that prevent exposure is based on the following convention:

“Prevent *receptor* exposure to *plume/site* groundwater with *COC* concentrations greater than the *clean up criteria* of *value*.”

Changes to the RAOs in some of the RODs are necessary to address these clarifications and to achieve consistency across all plumes/sites.

Additionally, the wording used in the RAO to describe how a remedy will restore groundwater to its beneficial use has evolved over time. The updated language is: “*Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.*” Changes to the RAO language for several sites is necessary to address this updated language.

All changes to the wording of the RAOs (if/where necessary) are described in [Table 3-2](#). The updated RAOs with all changes incorporated for all plumes/sites addressed in this ESD are listed in [Table 3-3](#).

3.1.2 Revisions to the Phrasing of LUCs

The following recommendation was made in the *Final 3rd Five Year Review, 2002-2007 Massachusetts Military Reservation Superfund Site* (AFCEE 2008a):

“...to ensure long-term protectiveness all groundwater sites with off-base plume areas must undergo the well verification process... It is recommended that this requirement be codified in an ESD for those off-base groundwater

sites with RODs that do not currently contain the well verification language as part of the required LUCs.”

The appropriate LUC well verification language had previously been incorporated into the RODs for CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 via an ESD, and was included in the final RODs for sites Ashumet Valley, CS-10, CS-19, CS-23, and LF-1 ([Table 1-1](#)). However, the LUC well verification language is not present in the RODs for sites FS-1, FS-12, and SD-5. In response to this recommendation, the following LUC well verification language will be incorporated into the RODs for FS-1, FS-12, and SD-5:

Within three years of the signing of the Record of Decision (ROD), the Air Force shall:

- a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the (FS-1, FS-12 or SD-5) plume.*
- b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the (FS-1, FS-12 or SD-5) plume, or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the U.S. Environmental Protection Agency (EPA), until the plume no longer presents a threat to that well as determined in coordination with EPA.*
- c. If the Air Force identifies a well containing contaminants of concern (COCs), the Air Force shall assess the risk that current and potential future non-drinking uses of such a well pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and approval.*
- d. If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate Board of Health (BOH). If the decommissioning is not accepted, the Air Force will take other steps to ensure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of*

contaminated groundwater from the (FS-1, FS-12 or SD-5) plume having carcinogens in excess of applicable or relevant and appropriate requirements (ARARs) (i.e., Maximum Contaminant Levels [MCLs], non-zero Maximum Contaminant Level Goals [MCLGs]), and prevent exposure to groundwater from the (FS-1, FS-12 or SD-5) plume that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic hazard index (HI) greater than one.

The current (June 2010) extent of the areas subject to the well verification process per this LUC requirement for each of the plumes addressed in this ESD is shown on [Figure 3-1](#). Note that these “LUC areas” for each plume shown on [Figure 3-1](#) are determined based on the current plume boundary. When plume boundaries are updated based on the availability of new monitoring data, the extent of the LUC areas are also re-assessed and re-defined as necessary, with regulatory concurrence.

3.1.3 Inclusion of Monitored Natural Attenuation

The EPA defines MNA as the

"reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants." (EPA, OSWER Directive 9200.4-17P).

And goes on to state

In the majority of cases where MNA is proposed as a remedy, its use may be appropriate as one component of the total remedy, that is, either in conjunction with active remediation or as a follow-up measure.”

With the exception of CS-19, none of the selected remedies for the groundwater plumes at the MMR subject to this ESD include MNA as a stated component of the remedy in the RODs. However, the NA processes are contributing to the overall remediation of the MMR plumes regardless of whether active treatment is ongoing. This is evidenced by declining COC concentration trends in portions of the plumes that are unaffected by the operation of the remedial systems. It is expected that the operation of NA processes in these portions of the plumes that are not being addressed by active treatment will lead to the achievement of RAOs in a reasonable timeframe. Regardless of which NA processes are at work, the fact that NA is occurring, both within and outside the hydraulic capture zones of the remedial systems, and that the Air Force’s remedies rely in part of NA to achieve cleanup levels throughout the contaminated plumes, necessitates including this remedial process as a stated component of the final remedies for all of the IRP groundwater plumes.

The degree to which NA is relied upon for achieving RAOs will vary depending on the plume. For example, portions of plumes that were not intended to be captured by the remedial systems (e.g., Ashumet Valley, CS-4, CS-10, CS-20, CS-23, FS-1, FS-28, FS-29, and LF-1) are more reliant on NA to achieve RAOs than other plumes where the remedial system was designed for plume containment (e.g., FS-12 and CS-21). [Figure 3-2](#) shows the approximate extent of the areas within each plume (based on the current plume boundaries and remedial system operation) where the remedial action is reliant on: (i) a combination of active treatment (through operation of the pump and treat remedial systems) and NA; and (ii) solely on the mechanisms of NA. As illustrated on [Figure 3-2](#), NA mechanisms alone are occurring at portions of the following plumes:

- Ashumet Valley: The portion of the Ashumet Valley plume south of Hayway Road with the exception of the southern portion of the plume that is being hydraulically captured through the operation of the leading edge ETD system.
- CS-4: The portion of the CS-4 plume formerly located south of the southernmost CS-4 remedial system extraction well near Boxberry Hill Road. It is noted that CS-4 COC concentrations in this area have already declined below the MCL through NA mechanisms and therefore this area is no longer depicted on [Figure 3-2](#).
- CS-10: The CS-10 North Central and CS-10 Southern lobes.
- CS-20: The portion of the CS-20 plume located south of Boxberry Hill Road where the southernmost remedial system extraction well is located.
- CS-23: The portion of the CS-23 plume located to the west of the two CS-23 remedial system extraction wells.
- FS-1: The portion of the FS-1 plume located between the southernmost remedial system extraction well and the Quashnet River and bogs.
- FS-28: The small area of residual EDB contamination near the former SWP system and the portion of the leading edge lobe located between the southernmost remedial system extraction well and Pond 14.
- FS-29: The portion of the FS-29 plume formerly located to the west of the two remedial system extraction wells. It is noted that FS-29 COC concentrations in this area have already declined below the MCL/MMCL through NA mechanisms and therefore this area is no longer depicted on [Figure 3-2](#).
- LF-1: The portion of the LF-1 plume (both northern lobe and southern lobe) located to the west of the MMR base boundary.

As such, the final remedies for all the plumes subject to this ESD (with the exception of CS-19 since MNA is already part of the selected remedy) will be updated to include MNA as a component to the overall remedy by adding the following text to each ROD.

Monitored Natural Attenuation (MNA) is included as a component of the final remedy for the (Ashumet Valley, CS-4, CS-10, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, SD-5) groundwater plume. The effects of natural attenuation (NA) are expected to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater over time, both within portions of the plumes that are targeted by the groundwater extraction and treatment systems, and areas that are not (i.e., uncaptured portions). The operation of NA will be verified through the comprehensive

long-term monitoring program which will include periodic collection of groundwater samples from areas within the plume extent as well as from areas up-, cross-, and down-gradient from the plume. While largely intended to work in concert with existing active remedies such as groundwater extraction and treatment systems, MNA may also allow for cost-effective achievement of cleanup goals in the final stages of remediation and for areas of the plumes where concentrations of the contaminants of concern (COCs) have decreased to levels that make continued use of active remedy components unnecessary (i.e., extraction wells are no longer efficiently contributing to achieving the remedial action objectives [RAOs]).

3.1.4 Base-Wide, Three-Step Process

AFCEE, EPA, and the MassDEP collectively developed a process to reach RAOs that was outlined in the Southwest Operable Unit (SWOU [comprised of CS-4, FS-13, CS-20, CS-21, FS-28, and FS-29]) RODs in 2000 (AFCEE 2000a and 2000c). Very briefly stated, the process called for first remediating the aquifer to state and federal drinking water standards, next conducting a risk assessment to determine if unacceptable risks were posed by residual contamination and to determine how remediation should continue, and lastly (after acceptable risks have been achieved) evaluating the technical and economic feasibility of restoring the aquifer to background conditions. As the IRP at MMR matured and more was learned about how the plumes change with time in response to restoration activities, it became apparent to AFCEE and the regulatory agencies that revisions to the three-step process were necessary to more accurately reflect the strategy for achieving site closure. In 2002, AFCEE and the regulatory agencies revised the three-step process.

The substantial change made to the three-step process in 2002 was that AFCEE is no longer required to demonstrate that contaminants have declined to concentrations below cleanup levels (e.g., MCLs and MMCLs) in the aquifer before proceeding with the second and third steps in the process. The revised process continues to require AFCEE to conduct a residual risk assessment, if deemed necessary, to determine appropriate

measures to achieve acceptable risk and to evaluate the technical and economic feasibility of achieving background concentrations in the aquifer after acceptable risk levels have been achieved.

The first step in the three-step process is slightly different for plumes that have active remedial systems (e.g., Ashumet Valley) than it is for plumes that do not have active remedial systems (e.g., FS-13). Specifically, for plumes that do not have active remedial systems, there is no need for system performance monitoring and evaluation to be included in the first step.

The more recent RODs prepared since 2006 (Ashumet Valley, FS-12, CS-10, CS-19, CS-23, LF-1, and CS-23) completed for the MMR include the stakeholder-agreed-upon language for this three-step process. The RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, FS-29 groundwater plumes had the revised three-step process incorporated per a 2008 ESD (AFCEE 2008b). However, these more recent RODs and the 2008 ESD incorrectly stated that the three-step process should be implemented to achieve RAOs rather than to achieve site closure as intended. Additionally, the ROD for FS-1 did not include the three-step process language because it predated its development. The ROD for SD-5 did not include the process because it contained no active remedy and therefore didn't originally consider this process relevant. Finally, the ROD language for FS-13 was revised to include the three-step process as part of the SWOU ESD (AFCEE 2008b), but it erroneously included the version of the three-step process intended for sites with active remediation.

As part of this ESD, the three-step process will be incorporated into all RODs for which it is missing (FS-1 and SD-5), inappropriately included (FS-13), or incorrectly stated as being a process to achieve RAOs rather than to achieve site closure (the remainder of the plumes subject to this ESD). The appropriate version is being added depending on whether or not an active remedial system is in-place for the plume. Specifically, the following language will be added to the RODs for Ashumet Valley, CS-4, CS-10, CS-20, CS-21, CS-23, FS-1, FS-12, FS-28, FS-29, and LF-1 (i.e., active remedy in place):

The Massachusetts Military Reservation (MMR) groundwater plumes, including the (Ashumet Valley, CS-4, CS-10, CS-20, CS-21, CS-23, FS-1, FS-12, FS-28, FS-29, or LF-1) plume, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected, it will undertake a three-step process in achieving site closure. This three-step process will be implemented in the following manner:

(1) During the period that treatment systems are remediating the aquifer to federal and state drinking water standards or other risk-based cleanup levels, AFCEE will monitor the plume in accordance with an approved system performance monitoring plan. The performance monitoring program will collect data for evaluating (a) whether the system is performing as designed, (b) whether the system is impacting ecologically sensitive areas, (c) the potential for short-term health effects due to exposures during active remediation, and (d) when the selected remedy will attain the remediation goals in the Records of Decision (ROD(s)) or Explanation of Significant Differences (ESD(s)).

(2) In accordance with applicable U.S. Environmental Protection Agency (EPA) guidance, a residual risk assessment(s) will be performed to determine if unacceptable ecological and/or human health risks are present, system operation will continue, and/or additional measures will be pursued as required to achieve acceptable risks. AFCEE shall conduct a residual risk assessment(s), if deemed necessary, of all contaminants remaining in the aquifer associated with the (Ashumet Valley, CS-4, CS-10, CS-20, CS-21, CS-23, FS-1, FS-12, FS-28, FS-29, or LF-1) plume to determine whether the groundwater contamination continues to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly by AFCEE, in consultation with the EPA and the Massachusetts Department of Environmental Protection (MassDEP), and may result in aquifer cleanup that is more protective than the National Contingency Plan (NCP) point-of-departure risk of 10^{-6} [40 Code of Federal Regulations (CFR) Part 300.430 (e)(2)], if justified, based on the following site-specific factors: cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population, sensitivities, potential impacts on environmental receptors, and cross-media impacts (NCP Preamble, page 8717).

(3) Once acceptable risk levels have been achieved the technical and economic feasibility of additional remediation to approach or achieve background concentrations will be evaluated. AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:

(a) Technological – Not feasible if

- i. the existing technologies or modification cannot remediate to a level of no significant risk, or to levels that approach or achieve background; or*
- ii. the reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
- iii. the remedy does not or cannot be modified to meet other regulatory requirements.*

(b) Economic – The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels that approach or achieve background justifies related costs unless

- i. the incremental cost for the remedy is substantial and disproportional to the increased reduction of risk, environmental restoration and monetary and nonmonetary values; or*
- ii. the risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA with input from MassDEP have also agreed that in the event that implementation of this process leads to a mutual decision to undertake additional cleanup and such decision results in a significant or fundamental change to the remedial approach, cleanup levels, and/or costs documented in the final ROD, AFCEE will execute an ESD or ROD Amendment (with public comment), as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined by AFCEE in consultation with MassDEP and the EPA in accordance with the criteria set forth in EPA's "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents" (EPA 1999). In the event that a dispute arises regarding any of the determinations reached under the process outlined above, such dispute shall be resolved under the dispute resolution procedure of the MMR Federal Facilities Agreement (FFA).

Similarly, the following language will be added to the RODs for CS-19, FS-13 and SD-5 (i.e., no active remedy in place).

The Massachusetts Military Reservation (MMR) groundwater plumes, including the (CS-19, FS-13, or SD-5) plume, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed it will undertake a three-step process in achieving site closure. This three-step process will be implemented in the following manner:

(1) AFCEE will monitor the plume in accordance with an approved monitoring plan. The monitoring program will collect data for evaluating (a) whether the plume is attenuating as predicted, (b) the potential for short-

term health effects due to exposures, and (c) when the selected remedy will attain the remediation goals in the Records of Decision (ROD(s)) or Explanation of Significant Differences (ESD(s)).

(2) In accordance with applicable U.S. Environmental Protection Agency (EPA) guidance, a residual risk assessment(s) will be performed to determine if unacceptable ecological and/or human health risks are present, or additional measures will be pursued as required to achieve acceptable risks. AFCEE shall conduct a residual risk assessment(s), if deemed necessary, of all contaminants remaining in the aquifer associated with the (CS-19, FS-13, or SD-5) plume to determine whether the groundwater contamination continues to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly by AFCEE, in consultation with the EPA and the Massachusetts Department of Environmental Protection (MassDEP), and may result in aquifer cleanup that is more protective than the National Contingency Plan (NCP) point-of-departure risk of 10^{-6} [40 Code of Federal Regulations (CFR) Part 300.430 (e)(2)], if justified, based on the following site-specific factors: cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population, sensitivities, potential impacts on environmental receptors, and crossmedia impacts (NCP Preamble, page 8717).

(3) Once acceptable risk levels have been achieved, the technical and economic feasibility of additional remediation to approach or achieve background concentrations will be evaluated. AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:

(a) *Technological – Not feasible if*

- i. *the existing technologies or modification cannot remediate to a level of no significant risk, or to levels that approach or achieve background; or*
- ii. *the reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
- iii. *the remedy does not or cannot be modified to meet other regulatory requirements.*

(b) *Economic – The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels that approach or achieve background justifies related costs unless*

- i. *the incremental cost for the remedy is substantial and disproportional to the increased reduction of risk, environmental restoration, and monetary and nonmonetary values; or*

ii. the risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.

AFCEE and EPA, with input from MassDEP, have also agreed that in the event that implementation of this process leads to a mutual decision to undertake additional cleanup and such decision results in a significant or fundamental change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an ESD or ROD Amendment (with public comment), as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined by AFCEE in consultation with MassDEP and the EPA in accordance with the criteria set forth in EPA's "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents" (EPA 1999). In the event that a dispute arises regarding any of the determinations reached under the process outlined above, such dispute shall be resolved under the dispute resolution procedure of the MMR Federal Facilities Agreement (FFA).

3.2 EXPECTED OUTCOMES

The differences in the remedial or enforcement action, settlement, or consent decree presented in Section 3.1 of this ESD significantly change but do not fundamentally alter the remedy selected in each ROD with respect to scope, performance, or cost. They are intended primarily to ensure consistency of approach across all of the IRP groundwater sites/plumes.

4.0 STATUTORY DETERMINATION

This ESD modifies the remedies for following IRP Sites at the MMR: Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5 groundwater plumes. These remedies are protective of human health and the environment, comply with federal and Commonwealth of Massachusetts requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. The remedies for the IRP Ashumet Valley, CS-4, CS-10, CS-19, CS-20, CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5 groundwater plume sites utilize permanent solutions to the maximum extent practicable, and satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element, in accordance with Section 121 of CERCLA. While the changes and clarifications contained in this ESD are significant, none of the proposed changes fundamentally change any of the remedies with respect to scope, performance, or cost.

5.0 STATE AGENCY COMMENTS AND PUBLIC PARTICIPATION ACTIVITIES

As part of the ESD review process, the regulatory agencies (EPA and MassDEP) were given the opportunity to comment on the draft version of this ESD. Responses to the regulatory agency comments were documented in a 02 March 2011 Response to Comments Letter. Both agencies concurred with the AFCEE's responses on 05 April 2011.

5.1 CONCURRENCE FROM THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

MassDEP concurrence with this ESD can be found in [Appendix B](#).

5.2 PUBLIC PARTICIPATION ACTIVITIES

As provided in NCP §300.435(c)(2)(i), a formal public comment period is not required when issuing an ESD. However, periodic updates were made to the MMR Cleanup Team (MMRCT) and Senior Management Board regarding the major differences documented in this ESD. A summary presentation regarding the ESD was given to the MMRCT on 14 July 2010.

In accordance with Section 117(d) of CERCLA, 42 United States Code §9617(D), AFCEE will publish a notice in the Cape Cod Times and the Falmouth Enterprise that describes this ESD and its availability in the Administrative Record. In accordance with 40 CFR Section 300.435(c)(2)(i) and 300.825(a)(2), this ESD and all documents that support the changes and clarifications are contained in the Administrative Record for the Installation Restoration Program at MMR.

6.0 REFERENCES

- AFCEE. 2009a (September). *Final Chemical Spill-19 Record of Decision*. A4P-J23-05PC0829-M26-0005. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2009b (August). *Final Record of Decision for Chemical Spill-10 Groundwater*. A4P-J23-35BC02VA-M26-0018. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2009c (March). *Final Record of Decision for Ashumet Valley Groundwater*. A4P-J23-35BC02VA-M26-0015. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2008a (September). *Final 3rd Five-Year Review, 2002-2007 Massachusetts Military Reservation (MMR) Superfund Site, Otis Air National Guard Base, MA*. Prepared by ESC, Portage and CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.
- _____. 2008b (September). *Final Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, Fuel Spill-13, Fuel Spill-28 and Fuel Spill-29 Groundwater Plumes*. A4P-J23-35BC24VC-M26-0006. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2007a (September). *Final Record of Decision for Landfill-1 Source Area and Groundwater*. A4P-J23-35BC02VA-M26-0001. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2007b (September). *Final Chemical Spill-23 Plume Record of Decision*. A4P-J23-35BC02VA-M26-0002. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.
- _____. 2006a (October). *Final Record of Decision for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm Drain-5*. A3P-J23-35Z04802-M26-0008. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.
- _____. 2006b (September). *Final Record of Decision for Fuel Spill-12 Groundwater*. A3P-J23-35Z04802-M26-0010. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program. Otis ANG Base, MA.
- _____. 2000a (October). *Final Record of Decision for the Fuel Spill-28 and Fuel Spill-29 Plumes*. AFC-J23-35Q86101 -M26-0009. Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000b (April). *Record of Decision Area of Contamination FS-1*. Prepared by HAZWRAP, Oak Ridge, TN. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

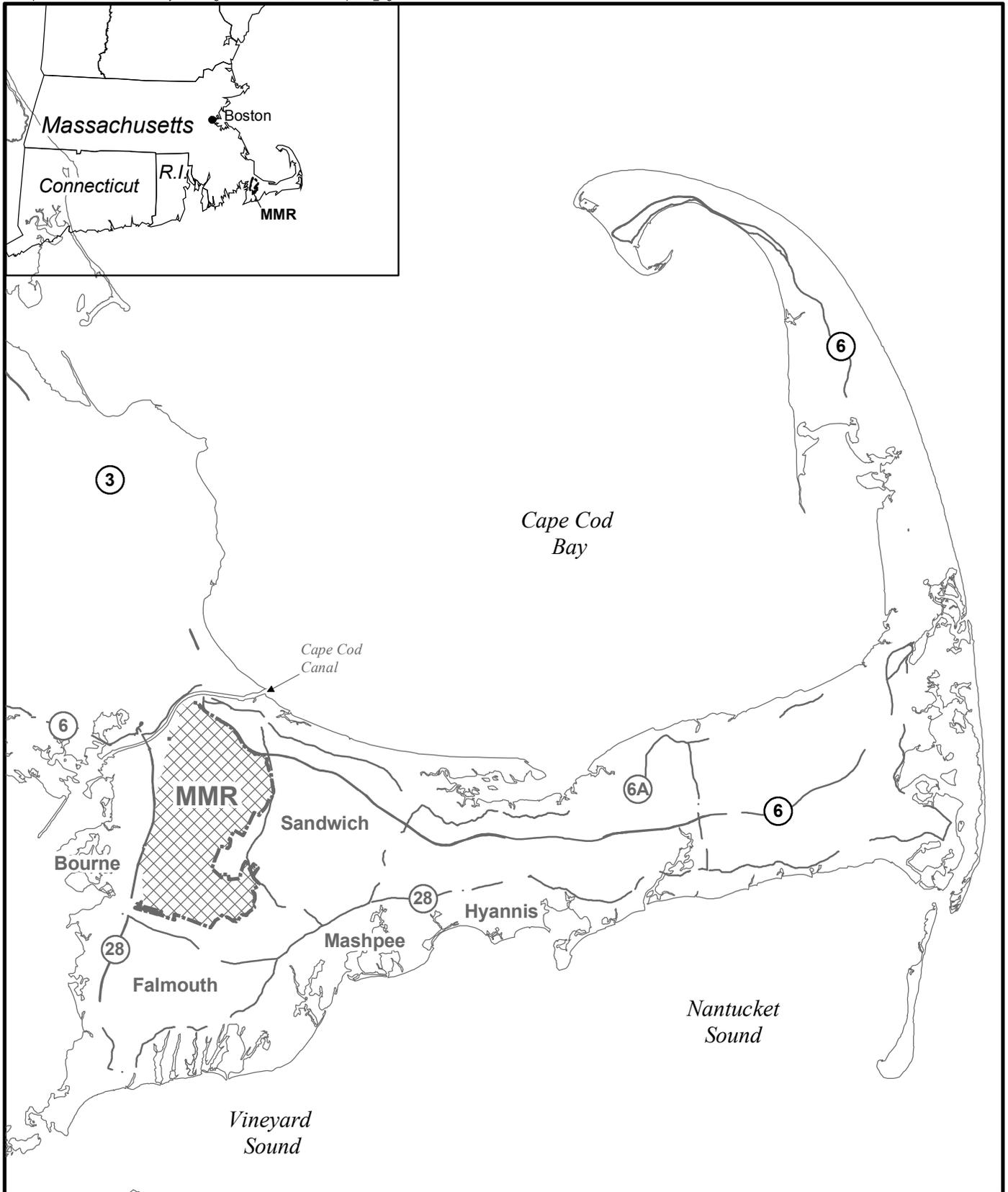
_____. 2000c (February). *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes*. AFC-J23-35Q86101-M26-0004. Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

EPA Region I, Department of the Air Force National Guard Bureau, and the U.S. Coast Guard. 2002 (June). *Federal Facility Agreement (FFA) Under CERCLA S120 and RCRA S7003 for the Massachusetts Military Reservation* as amended.

EPA Region I and the United States Department of Defense, National Guard Bureau. 1991 (and subsequently amended). *Federal Facility Agreement Under CERCLA § 120 and RCRA § 7003* In the matter of: The U.S. Department of Defense, National Guard Bureau, Massachusetts Military Reservation, Cape Cod, MA.

U.S. EPA. 1999 (July). *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*. EPA 540/R-98/031, OSWER 9200.1-23P.

FIGURES



Legend



Massachusetts Military Reservation

Data Source: AFCEE, MMR-AFCEE Data Warehouse



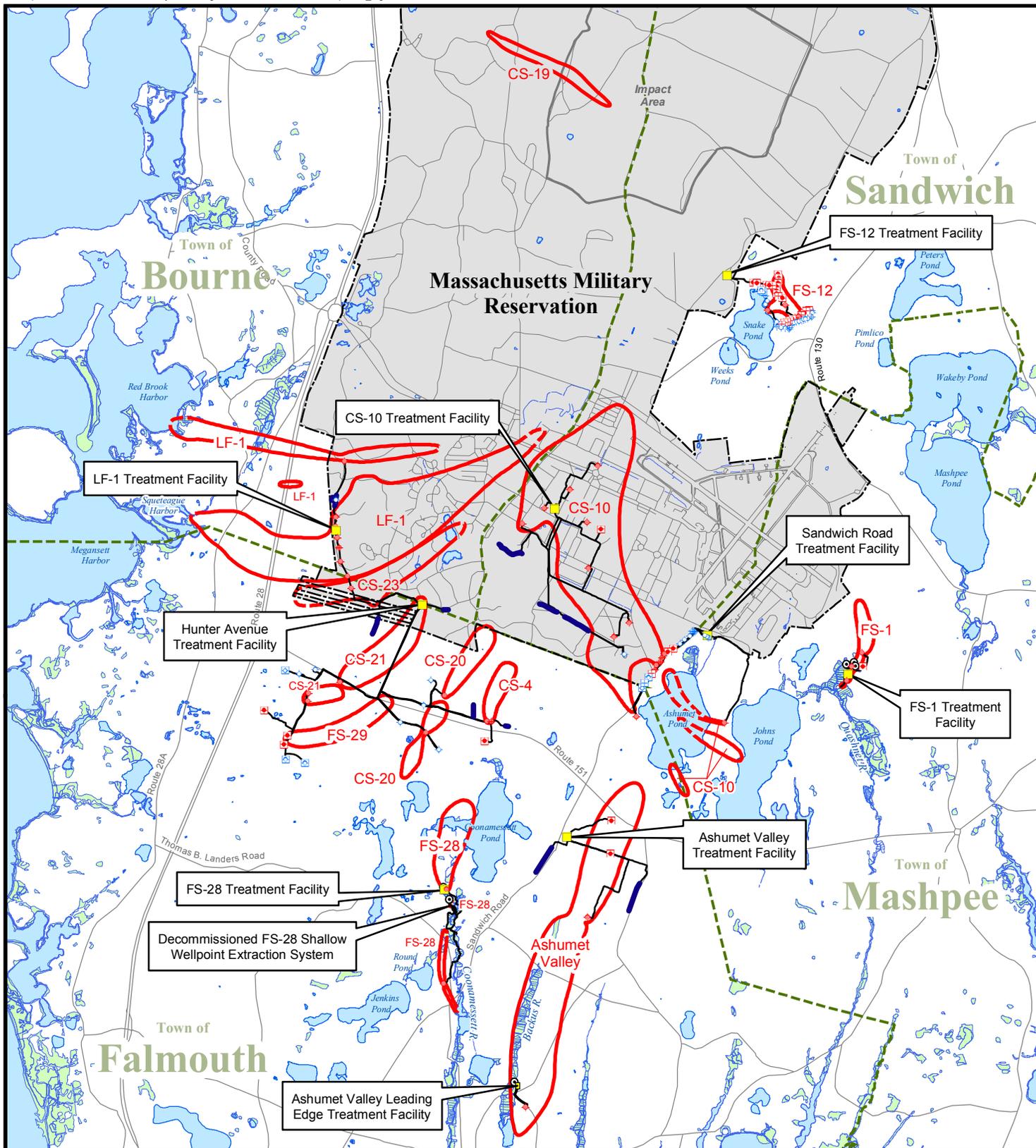
0 3 6
Miles

FIGURE 1-1

MASSACHUSETTS MILITARY RESERVATION, CAPE COD, MASSACHUSETTS

Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation

CH2MHILL®



Data Source: AFCEE, October 2010, AFCEE-MMR Data Warehouse

Legend

- Plume Boundary (Dashed Where Inferred)
Defines Area of Groundwater Contaminants of Concern Above Regulatory Limits
- ◆ ReInjection Well
- ◆ Extraction Well
- ReInjection Well (Off)
- Extraction Well (Off)
- Outflow Bubbler
- Treatment Facility
- Treatment System Piping
- Infiltration Gallery/Trench
- - - Town Boundary
- Bog/Wetland

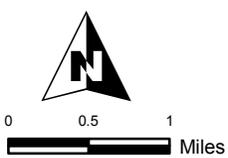
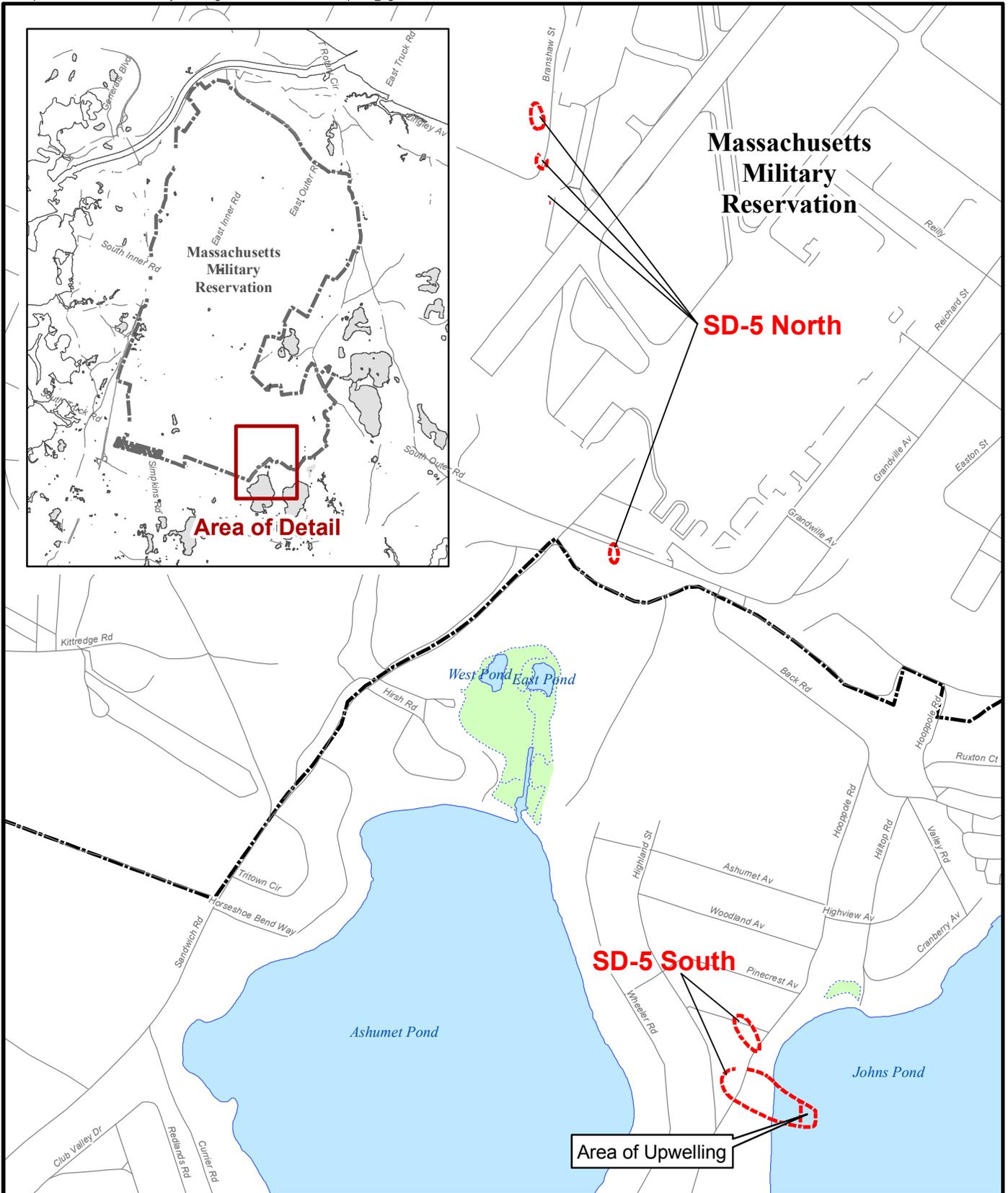


FIGURE 1-2

IRP GROUNDWATER PLUMES, MASSACHUSETTS MILITARY RESERVATION - OCTOBER 2010

Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation



Data Source: AFCEE, MMR-AFCEE Data Warehouse

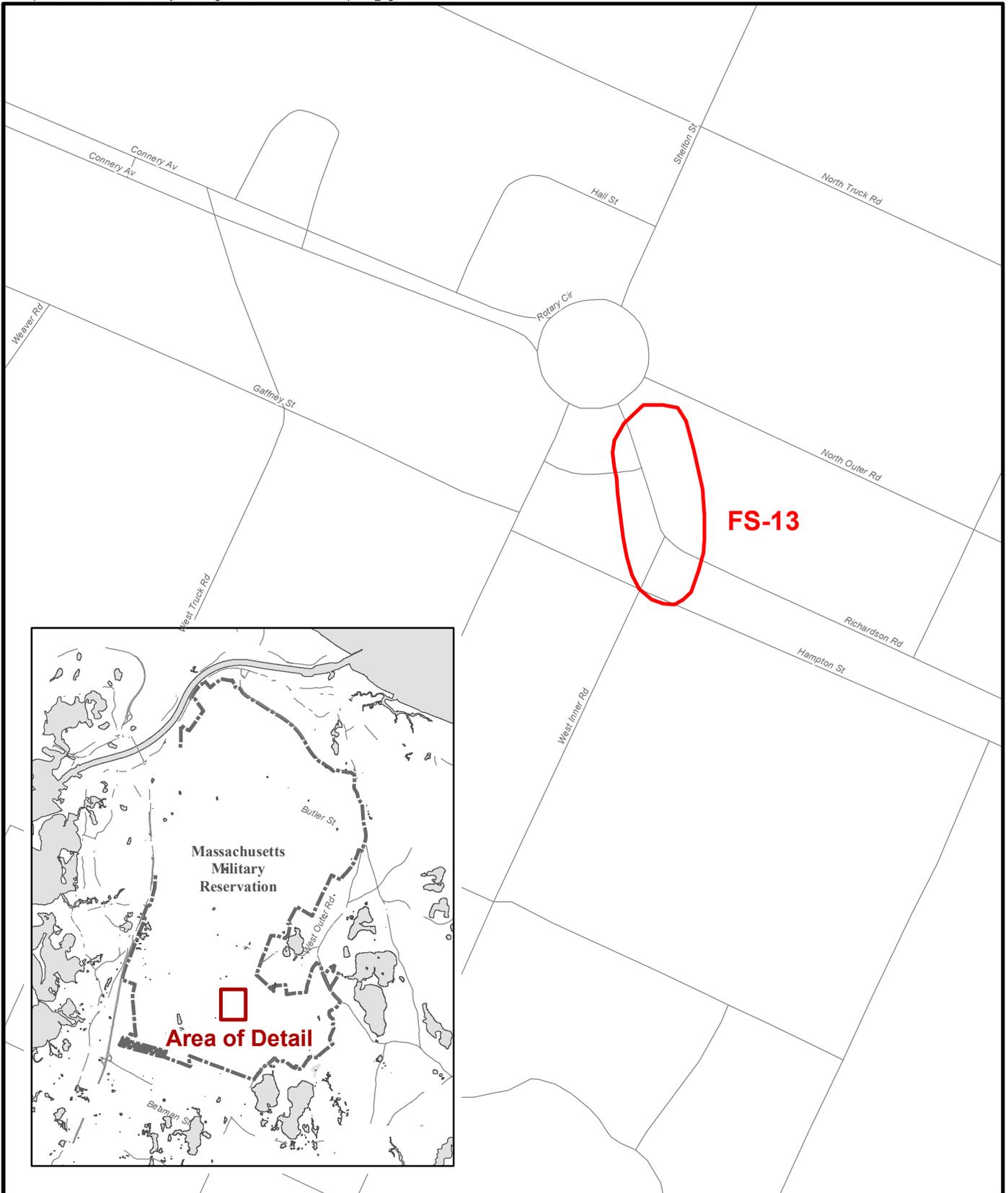
Legend

-  Massachusetts Military Reservation Boundary
-  Plume Boundary (Dashed Where Inferred)
-  Bog/Wetland

FIGURE 2-1

HISTORIC DELINEATION OF THE SD-5 GROUNDWATER PLUME - 2005

Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation



Data Source: AFCEE, MMR-AFCEE Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)

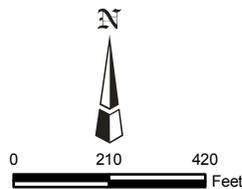
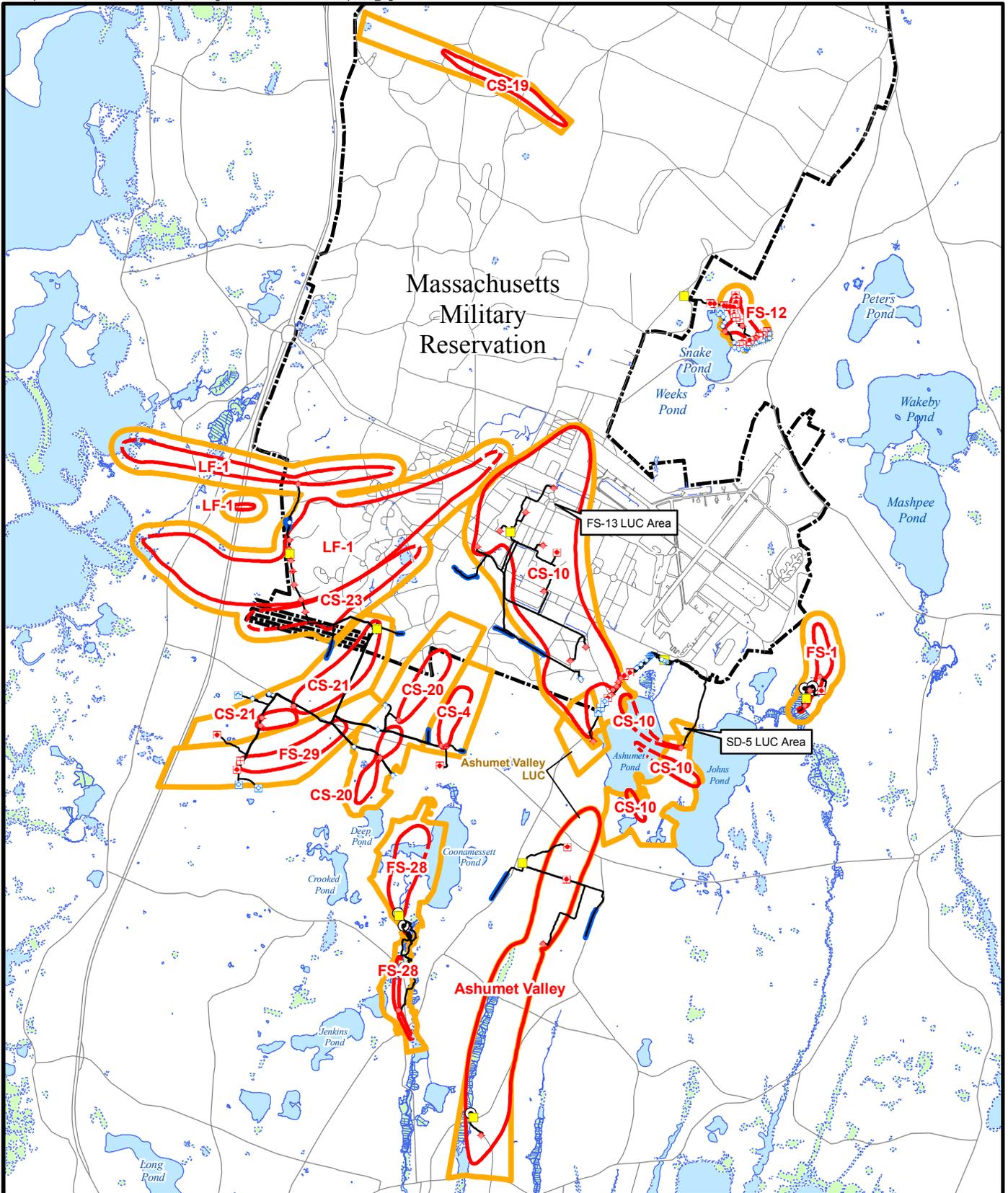


FIGURE 2-2

HISTORIC DELINEATION OF THE FS-13 GROUNDWATER PLUME - 2004

Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation



Data Source: AFCEE, October 2010, AFCEE-MMR Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Infiltration Trench/Gallery
- Treatment System Pipeline
- Land Use Control Area
- Treatment Facility
- ◆ Extraction Well (On)
- ◇ Reinjection Well (On)
- Extraction Well (Off)
- ◇ Reinjection Well (Off)
- ⊙ Outflow Bubbler

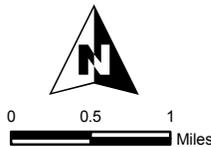
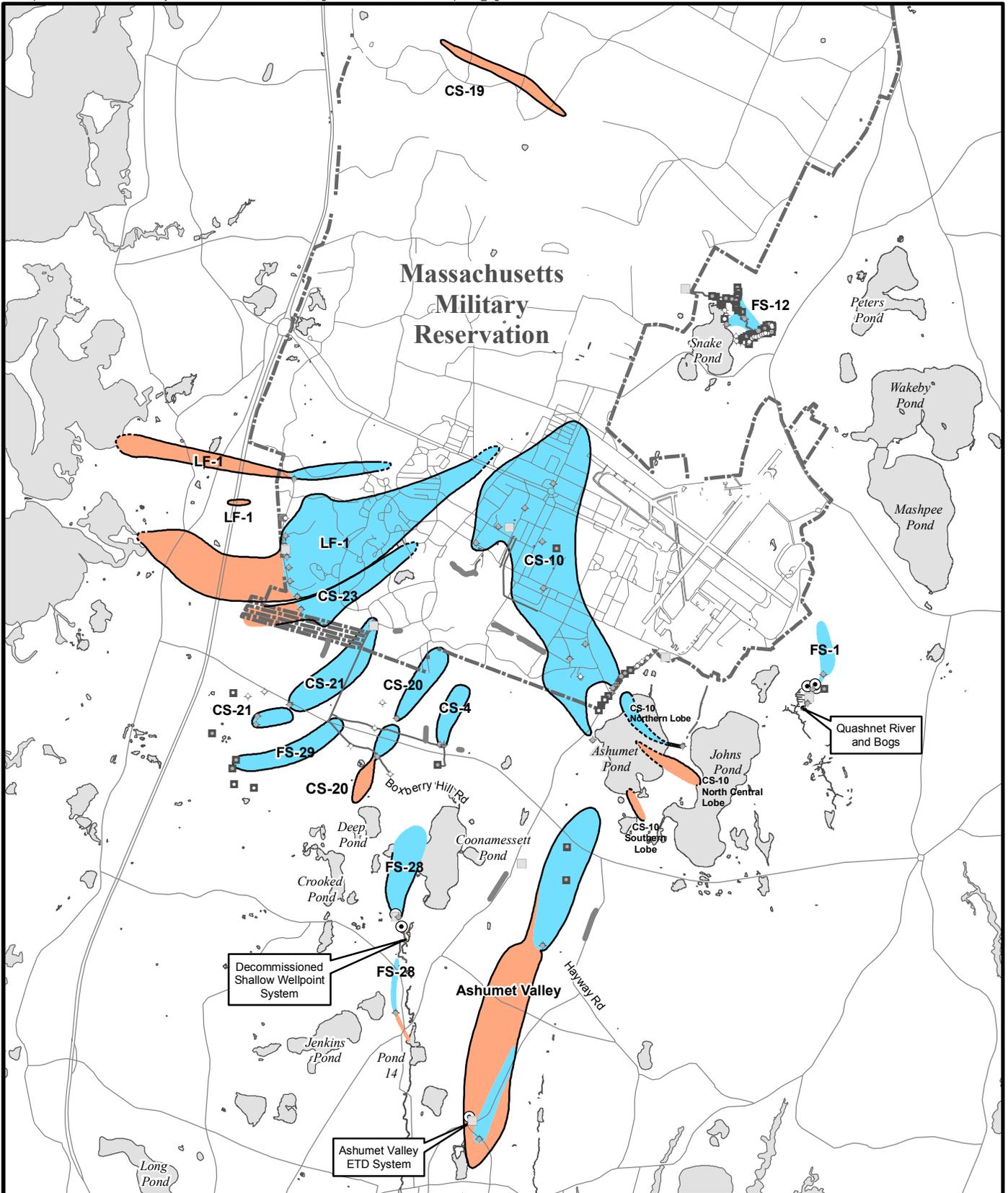


FIGURE 3-1

IRP PLUMES, TREATMENT SYSTEMS AND LAND USE CONTROL AREAS - OCTOBER 2010

Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation



Legend Data Source: AFCEE, October 2010, AFCEE-MMR Data Warehouse

- Massachusetts Military Reservation Boundary
- - - Plume Boundary (Dashed Where Inferred)
- Infiltration Trench/Gallery
- Treatment System Pipeline
- Remedy Relies on Active Treatment and Natural Attenuation
- Remedy Relies on Natural Attenuation
- Treatment Facility
- ◆ Extraction Well (On)
- ◇ Reinjection Well (On)
- Extraction Well (Off)
- Reinjection Well (Off)
- Outflow Bubbler

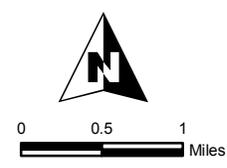


FIGURE 3-2
IRP PLUMES, TREATMENT SYSTEMS AND REMEDIAL TECHNOLOGY DESIGNATION
Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation

TABLES

Table 1-1
Summary of ROD Submittals for MMR Sites Subject to ESD
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Site	Final ROD Date	Date of ROD Signatures		Citation
		USAF	EPA	
Ashumet Valley	March 2009	01 May 2009	10 June 2009	AFCEE 2009c
CS-4*	February 2000	01 February 2000	18 February 2000	AFCEE 2000c
CS-10	August 2009	02 August 2009	19 August 2009	AFCEE 2009b
CS-19	September 2009	25 September 2009	30 September 2009	AFCEE 2009a
CS-20*	February 2000	01 February 2000	18 February 2000	AFCEE 2000c
CS-21*	February 2000	01 February 2000	18 February 2000	AFCEE 2000c
CS-23	September 2007	24 September 2007	28 September 2007	AFCEE 2007b
FS-1	April 2000	04 May 2000	15 May 2000	AFCEE 2000b
FS-12	September 2006	15 September 2006	28 September 2006	AFCEE 2006b
FS-13*	February 2000	01 February 2000	18 February 2000	AFCEE 2000c
FS-28*	October 2000	16 October 2000	23 October 2000	AFCEE 2000a
FS-29*	October 2000	16 October 2000	23 October 2000	AFCEE 2000a
LF-1	September 2007	24 September 2007	28 September 2007	AFCEE 2007a
SD-5	October 2006	14 August 2006	28 September 2006	AFCEE 2006a

Note:

* - The selected remedies in the RODs for these sites was modified through issuance of the *Final Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, Fuel Spill-13, Fuel Spill-28 and Fuel Spill-29 Groundwater Plumes*. (AFCEE 2008b).

Key:

CS = Chemical Spill
EPA = U.S. Environmental Protection Agency
FS = Fuel Spill
LF = Landfill
ROD = Record of Decision
SD = Storm Drain
USAF = U.S. Air Force

Table 3-1
Summary of Main Changes included in ESD
Final Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes
at the Massachusetts Military Reservation

Site	ROD/ESD Status and Completion Year*	RAO Phrasing for Consistency	Well Verification Process under LUCs	Clarify MNA as Component of Remedy	3-Step Process Language
Ashumet Valley	ROD - 2009	NO CHANGE	NO CHANGE	ADD	UPDATE
CS-4	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE
CS-10	ROD - 2009	UPDATE	NO CHANGE	ADD	UPDATE
CS-19	ROD - 2009	UPDATE	NO CHANGE	NO CHANGE (MNA in remedy)	UPDATE (use language for sites with no active treatment remedy)
CS-20	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE
CS-21	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE
CS-23	ROD - 2007	UPDATE	NO CHANGE	ADD	UPDATE
FS-1	ROD - 2000	UPDATE	ADD	ADD	UPDATE
FS-12	ROD - 2006	UPDATE	ADD	ADD	UPDATE
FS-13	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE (use language for sites with no active treatment remedy)
FS-28	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE
FS-29	ROD - 2000 ESD - 2008	UPDATE	NO CHANGE	ADD	UPDATE
LF-1	ROD - 2007	UPDATE	NO CHANGE	ADD	UPDATE
SD-5	ROD - 2006	UPDATE	ADD	ADD	UPDATE (use language for sites with no active treatment remedy)

Notes:

* Refer to Table 1-1 for more details

Key:

CS = Chemical Spill

ESD = Explanation of Significant Differences

FS = Fuel Spill

LF = Landfill

LUCs = Land Use Controls

MNA = Monitored Natural Attenuation

RAO = Remedial Action Objective

ROD = Record of Decision

SD = Storm Drain

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
Ashumet Valley	<ul style="list-style-type: none"> • Prevent residential exposure to Ashumet Valley groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to Ashumet Valley groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the Ashumet Valley plume and that contains manganese concentrations greater than the lifetime HA of 300 µg/L. • Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the Ashumet Valley plume and that contains thallium concentrations greater than the MCL of 2 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. 	<ul style="list-style-type: none"> • No changes necessary.
CS-4	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to EDB, PCE, TCE, and 1,1,2,2-TCA in excess of cleanup standards in groundwater. • Restore the aquifer to its beneficial uses within a reasonable time frame. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to CS-4 groundwater with EDB, PCE, TCE, and 1,1,2,2-TCA in excess of cleanup standards in groundwater concentrations greater than the MMCL of 0.02 µg/L • Prevent residential exposure to CS-4 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-4 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-4 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time frame.

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
CS-10	<ul style="list-style-type: none"> Prevent residential exposure to CS-10 groundwater containing concentrations of TCE or PCE greater than 5 µg/L. Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. 	<ul style="list-style-type: none"> Prevent residential exposure to CS-10 groundwater with containing concentrations of TCE concentrations or PCE greater than the MCL of 5 µg/L. Prevent residential exposure to CS-10 groundwater with PCE concentrations greater than the MCL of 5 µg/L. Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-19	<ul style="list-style-type: none"> Prevent residential exposure to CS-19 groundwater containing concentrations of RDX greater than 0.6 µg/L. Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. 	<ul style="list-style-type: none"> Prevent residential exposure to CS-19 groundwater with RDX containing concentrations of RDX greater than the risk-based level of 0.6 µg/L. Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-20	<ul style="list-style-type: none"> Prevent or reduce residential exposure to PCE exceeding 5 µg/L in groundwater. Restore the aquifer to its beneficial uses within a reasonable time. 	<ul style="list-style-type: none"> Prevent or reduce residential exposure to CS-20 groundwater with PCE concentrations greater than the MCL of exceeding 5 µg/L in groundwater. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time.
CS-21	<ul style="list-style-type: none"> Prevent or reduce residential exposure to TCE exceeding 5 µg/L in groundwater. Restore the aquifer to its beneficial uses within a reasonable time. 	<ul style="list-style-type: none"> Prevent or reduce residential exposure to CS-21 groundwater with TCE concentrations greater than the MCL of exceeding 5 µg/L in groundwater. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time.

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
CS-23	<ul style="list-style-type: none"> • Prevent residential exposure to CS-23 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-23 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. • Prevent exposure to CS-23 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or present a non-carcinogenic hazard index greater than 1.0. 	<ul style="list-style-type: none"> • Prevent residential exposure to CS-23 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-23 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. • Prevent exposure to CS-23 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or present a non-carcinogenic hazard index greater than 1.0.
FS-1	<ul style="list-style-type: none"> • Prevent or reduce exposure to groundwater COCs exceeding cleanup standards in groundwater; • Restore the aquifer to beneficial uses within a reasonable time frame; and • Prevent or reduce worker, recreational youth, and adult wader contact with Quashnet River water containing unacceptable concentrations of EDB and ingestion of fish exposed to Quashnet River water containing unacceptable concentrations of EDB. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L COCs exceeding cleanup standards in groundwater. • Prevent residential exposure to FS-1 groundwater with lead concentrations greater than the EPA Treatment Technique action level of 15 µg/L. • Prevent residential exposure to FS-1 groundwater with thallium concentrations greater than the MCL of 2 µg/L. • Prevent residential exposure to FS-1 groundwater with toluene concentrations greater than the MCL of 1,000 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to beneficial uses within a reasonable time frame • Prevent or reduce worker, recreational youth, and adult wader contact with Quashnet River water containing unacceptable concentrations of EDB and ingestion of fish exposed to Quashnet River water containing unacceptable concentrations of EDB.

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
FS-12	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-12 groundwater with benzene concentrations greater than the MCL of 5 µg/L. • Prevent or reduce residential exposure to FS-12 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. • Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-12 groundwater with benzene concentrations greater than the MCL of 5 µg/L. • Prevent or reduce residential exposure to FS-12 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. • Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
FS-13	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene exceeding 17 µg/L in groundwater. • Restore the aquifer to its beneficial uses within a reasonable time. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-13 groundwater with 1,2,4-TMB and 1,3,5-trimethylbenzene exceeding concentrations greater than the risk-based level of 17 µg/L in groundwater. • Prevent residential exposure to FS-13 groundwater with 1,3,5-TMB concentrations greater than the risk-based level of 17 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time.
FS-28	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to EDB exceeding 0.02 µg/L in groundwater. • Restore the aquifer to its beneficial uses within a reasonable time. • Prevent worker contact and child and adult wader contact with Coonamessett River water containing unacceptable concentrations of EDB. • Prevent or reduce ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-28 groundwater with EDB concentrations greater than the MMCL of exceeding 0.02 µg/L in groundwater. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time. • Prevent worker contact and child and adult wader contact with Coonamessett River water containing unacceptable concentrations of EDB. • Prevent or reduce ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB.

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
FS-29	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to EDB exceeding 0.02 µg/L and CCl₄ exceeding 5 µg/L in groundwater. • Restore the aquifer to its beneficial uses within a reasonable time. 	<ul style="list-style-type: none"> • Prevent or reduce residential exposure to FS-29 groundwater with EDB concentrations greater than the MMCL of exceeding 0.02 µg/L and CCl₄ exceeding 5 µg/L in groundwater. • Prevent residential exposure to FS-29 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Restore the aquifer to its beneficial uses within a reasonable time.
LF-1	<ul style="list-style-type: none"> • Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable. • Prevent risks to human health and the environment (if any) posed by the landfill. • Prevent residential exposure to LF-1 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with vinyl chloride concentrations greater than the MCL of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,4-dichlorobenzene concentrations greater than the MMCL of 5 µg/L. 	<ul style="list-style-type: none"> • Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable. • Prevent risks to human health and the environment (if any) posed by the landfill. • Prevent residential exposure to LF-1 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with vinyl chloride concentrations greater than the MCL of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,4-dichlorobenzene concentrations greater than the MMCL of 5 µg/L.

Table 3-2
Summary of Changes to RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation

Plume/ Site	Original RAOs	Revised RAOs (changes shown shaded in grey)
	<ul style="list-style-type: none"> Prevent residential exposure to LF-1 groundwater with manganese concentrations greater than the Health Advisory of 300 µg/L. Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or present a non-carcinogenic hazard index greater than 1.0. 	<ul style="list-style-type: none"> Prevent residential exposure to LF-1 groundwater with manganese concentrations greater than the Health Advisory of 300 µg/L. Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or present a non-carcinogenic hazard index greater than 1.0.
SD-5	<ul style="list-style-type: none"> Prevent or reduce exposure to on-base and off-base SD-5 groundwater with TCE concentrations greater than the MCL of 5 µg/L. Return usable groundwater to beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. 	<ul style="list-style-type: none"> Prevent or reduce residential exposure to on-base and off-base SD-5 groundwater with TCE concentrations greater than the MCL of 5 µg/L. Restore Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

Key:

CCl₄ = carbon tetrachloride
COC = contaminant of concern
CS = Chemical Spill
EDB = ethylene dibromide
EPA = U.S. Environmental Protection Agency
FS = Fuel Spill
GW-1 = Massachusetts Contingency Plan Groundwater-1 Standard
HA = Health Advisory
LF = Landfill
MCL = Maximum Contaminant Level

MMCL = Massachusetts MCL
PCE = tetrachloroethene
RAO = Remedial Action Objective
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
SD = Storm Drain
TCE = trichloroethene
µg/L = micrograms per liter
1,1,2,2-TeCA = 1,1,2,2-tetrachloroethane
1,2,4-TMB = 1,2,4-trimethylbenzene
1,3,5-TMB = 1,3,5-trimethylbenzene

**Table 3-3
Updated RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation**

Plume/ Site	Updated RAOs
Ashumet Valley	<ul style="list-style-type: none"> • Prevent residential exposure to Ashumet Valley groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to Ashumet Valley groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the Ashumet Valley plume and that contains manganese concentrations greater than the lifetime HA of 300 µg/L. • Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the Ashumet Valley plume and that contains thallium concentrations greater than the MCL of 2 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-4	<ul style="list-style-type: none"> • Prevent residential exposure to CS-4 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L • Prevent residential exposure to CS-4 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-4 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-4 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-10	<ul style="list-style-type: none"> • Prevent residential exposure to CS-10 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-10 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-19	<ul style="list-style-type: none"> • Prevent residential exposure to CS-19 groundwater with RDX concentrations greater than the risk-based level of 0.6 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-20	<ul style="list-style-type: none"> • Prevent residential exposure to CS-20 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-21	<ul style="list-style-type: none"> • Prevent residential exposure to CS-21 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
CS-23	<ul style="list-style-type: none"> • Prevent residential exposure to CS-23 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to CS-23 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

**Table 3-3
Updated RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation**

Plume/ Site	Updated RAOs
	<ul style="list-style-type: none"> Prevent exposure to CS-23 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or present a non-carcinogenic hazard index greater than 1.0.
FS-1	<ul style="list-style-type: none"> Prevent residential exposure to FS-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. Prevent residential exposure to FS-1 groundwater with lead concentrations greater than the EPA Treatment Technique action level of 15 µg/L. Prevent residential exposure to FS-1 groundwater with thallium concentrations greater than the MCL of 2 µg/L. Prevent residential exposure to FS-1 groundwater with toluene concentrations greater than the MCL of 1,000 µg/L. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Prevent worker, recreational youth, and adult wader contact with Quashnet River water containing unacceptable concentrations of EDB and ingestion of fish exposed to Quashnet River water containing unacceptable concentrations of EDB.
FS-12	<ul style="list-style-type: none"> Prevent residential exposure to FS-12 groundwater with benzene concentrations greater than the MCL of 5 µg/L. Prevent residential exposure to FS-12 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
FS-13	<ul style="list-style-type: none"> Prevent residential exposure to FS-13 groundwater with 1,2,4-TMB concentrations greater than the risk-based level of 17 µg/L. Prevent residential exposure to FS-13 groundwater with 1,3,5-TMB concentrations greater than the risk-based level of 17 µg/L. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
FS-28	<ul style="list-style-type: none"> Prevent residential exposure to FS-28 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. Prevent worker contact and child and adult wader contact with Coonamessett River water containing unacceptable concentrations of EDB. Prevent ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB.
FS-29	<ul style="list-style-type: none"> Prevent residential exposure to FS-29 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. Prevent residential exposure to FS-29 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.
LF-1	<ul style="list-style-type: none"> Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable. Prevent risks to human health and the environment (if any) posed by the landfill.

**Table 3-3
Updated RAOs
Final Explanation of Significant Differences for the Installation Restoration Program
Groundwater Plumes at the Massachusetts Military Reservation**

Plume/ Site	Updated RAOs
	<ul style="list-style-type: none"> • Prevent residential exposure to LF-1 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with PCE concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with CCl₄ concentrations greater than the MCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with vinyl chloride concentrations greater than the MCL of 2 µg/L. • Prevent residential exposure to LF-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L. • Prevent residential exposure to LF-1 groundwater with 1,4-dichlorobenzene concentrations greater than the MMCL of 5 µg/L. • Prevent residential exposure to LF-1 groundwater with manganese concentrations greater than the Health Advisory of 300 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. • Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2, that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or present a non-carcinogenic hazard index greater than 1.0.
SD-5	<ul style="list-style-type: none"> • Prevent residential exposure to SD-5 groundwater with TCE concentrations greater than the MCL of 5 µg/L. • Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

Key:

CCl₄ = carbon tetrachloride

COC = contaminant of concern

CS = Chemical Spill

EDB = ethylene dibromide

EPA = U.S. Environmental Protection Agency

FS = Fuel Spill

GW-1 = Massachusetts Contingency Plan Groundwater-1 Standard

HA = Health Advisory

LF = Landfill

MCL = Maximum Contaminant Level

MMCL = Massachusetts MCL

PCE = tetrachloroethene

RAO = Remedial Action Objective

RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine

SD = Storm Drain

TCE = trichloroethene

µg/L = micrograms per liter

1,1,2,2-TeCA = 1,1,2,2-tetrachloroethane

1,2,4-TMB = 1,2,4-trimethylbenzene

1,3,5-TMB = 1,3,5-trimethylbenzene

APPENDIX A

**Selected Remedies as Originally Described in the
Final RODs for the Following Installation Restoration Program
Groundwater Plumes at the Massachusetts Military
Reservation: Ashumet Valley, CS-4, CS-10, CS-19, CS-20,
CS-21, CS-23, FS-1, FS-12, FS-13, FS-28, FS-29, LF-1, and SD-5**

A.1 ASHUMET VALLEY

A description of the selected remedy for the Ashumet Valley Groundwater plume as specified in the Ashumet Valley ROD (AFCEE 2009c) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE ASHUMET VALLEY GROUNDWATER OPERABLE UNIT (OU)

An agreement could not be reached between AFCEE, EPA, and MassDEP on a preferred alternative based on the information available in the final FS. AFCEE had produced a PP with Alternative 6 as the preferred alternative (AFCEE 2007c) in June 2007. EPA, in turn produced an explanation of concerns that was released jointly with the AFCEE PP that advocated a more aggressive remedy than outlined in Alternative 6 (EPA 2007). Comments from the public collected up to August 2007 were mixed (Section 3.0) and indicated a consensus for a preferred alternative was not easily derived. It was agreed that additional data were required to fill in a number of data gaps in the distribution of contaminants in the Ashumet Valley plume. A comprehensive groundwater monitoring effort was conducted and a number of drive points were installed to help characterize the distribution of PCE and TCE in the downgradient portion of the Ashumet Valley plume. Plume shells representing January 2008 conditions for PCE and TCE were developed using these new data collected in the fall and winter 2007. Using these new plume shells, Alternative 7 was modified to address contamination downgradient of Carriage Shop Road and east of the Backus River. The major difference was the core of high concentrations of PCE had migrated farther south than the contamination predicted in the model in Alternative 7. Alternative 7 modified included one additional extraction well downgradient of Carriage Shop Road to intercept the core of the PCE plume. After a review of the modeling results, AFCEE, EPA, and MassDEP agreed to consider Alternative 7 modified as the remedy to be carried into the ROD. Based on the Administrative Record for Ashumet Valley and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 7 modified as the remedy for the Ashumet Valley groundwater OU.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 7 modified, which consists of continued operation of the current Ashumet Valley treatment system and the Ashumet Valley SPEIM program, the installation of one additional extraction well south of Carriage Shop Road and east of the Backus River to increase capture of the southern portion of the Ashumet Valley plume, and LUCs. The water from the additional extraction well will be pumped to a MTU in proximity to the extraction well for treatment and discharge to the Backus River. The selected remedy is protective of human health through implementation of LUCs, complies with ARARs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame and is cost-effective.

2.11.2 Detailed Description of Selected Remedy

The selected remedy is Alternative 7 modified, which consists of the existing optimized Ashumet Valley ETI system (one extraction well and two associated infiltration trenches) with an additional extraction well placed in the southern portion of the plume (Figure 2-13) to improve capture of the plume in that area. The additional flow from the southern extraction well is treated at a MTU in close proximity to the extraction well and discharged through a bubbler to the Backus River.

The ETI system consists of ETI of groundwater following federal and state standards for PCE and TCE as stipulated in the current O&M plan. The alternative has the flexibility of modifying the treatment system to optimize the cleanup time frame and to insure it continues to meet performance objectives. Most likely, modifications would be executed with the existing extraction wells and infiltration trenches and galleries, and could involve the use of packers to reduce the effective vertical extent of the extraction screen, or adjusting flow rates. However, the alternative does not exclude the possibility of adding additional system components, if deemed necessary. Modifications would be made for the purpose of improving treatment system operation and expediting the plume cleanup. The Ashumet Valley ETI system is not designed to remove manganese and

thallium from groundwater. The higher concentrations of manganese and thallium are located upgradient of the active extraction well(s) capture zone(s), are currently outside the known dimensions of the Ashumet Valley plume, and should attenuate in place rather than migrate toward the extraction wells. Manganese and thallium will be addressed through LTM of wells in an area west of Ashumet Pond designated for monitoring of these contaminants (Figure 2-13). The LTM will confirm that concentrations of manganese and thallium are decreasing.

This alternative would provide for chemical and hydraulic monitoring of the plume, as long as active remediation continues, and chemical monitoring of the plume until the RAOs are met. Monitoring data would aid in ongoing optimization and could prompt additional action if COC concentrations did not decrease as expected. Monitoring results will be periodically reported in formal reports. CERCLA reviews would be performed every five years throughout the lifetime of the alternative. A residual risk assessment and/or an evaluation of the technical and economic feasibility of additional remediation to approach background concentrations would be performed, if deemed necessary. The selected remedy also includes implementation of LUCs.

The following text describes the LUCs that will be implemented for the Ashumet Valley groundwater selected remedy. The Ashumet Valley contaminated groundwater currently poses an unacceptable risk to human health if used for household purposes (i.e., ingestion, dermal contact, and inhalation of vapors released during household use of water).

The Ashumet Valley contaminated groundwater is located in the southern part of the MMR cantonment area, and all of the contaminated groundwater has migrated past the MMR boundary into the neighboring town of Falmouth. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as “LUCs,” must be established for the Ashumet Valley groundwater to avoid the risk of exposure to Ashumet Valley groundwater. These LUCs are needed both on-base and off-base, within the town of Falmouth, until the Ashumet Valley contaminated groundwater no longer poses an unacceptable risk.

The performance objectives of the LUCs are to:

- *Prevent access to or use of the groundwater from the Ashumet Valley contaminated groundwater until the groundwater no longer poses an unacceptable risk; and*
- *Maintain the integrity of the current or future remedial or monitoring system such as the treatment systems and monitoring wells.*

The LUCs will encompass the area including the Ashumet Valley contaminated groundwater and surrounding areas to reduce the risk from exposure to contaminated groundwater (Figure 2-14). The on-base area of concern is controlled and operated by the Air Force, who leases this land from the Commonwealth of Massachusetts. It is expected that this entity (U.S. Air Force) will control the area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of COCs in the groundwater are at such levels as to allow unrestricted use and exposure, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following two LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. The Town of Falmouth has enforcement authority on the first LUC. The Commonwealth of Massachusetts only has enforcement authority regarding the second LUC. In the event that the Town of Falmouth fails to promptly enforce the first LUC or the Commonwealth of Massachusetts fails to promptly enforce the second LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s

(i.e., the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

(1) The Falmouth BOH requires a permit for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. If a permit to install a drinking water well is approved, the Falmouth BOH will not approve the use of that well until its water has been tested and the BOH has determined that the water is potable. The Falmouth BOH Water Well Regulations do not apply to use of existing drinking water wells and irrigation wells. The regulations, which are reproduced in Appendix C, cover documented and anticipated areas of contamination from the Ashumet Valley plume. To assist the Town of Falmouth in the implementation of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the Ashumet Valley plume within the town of Falmouth. While Figure 2-14 shows the current area of LUCs in the town, the Falmouth BOH may modify the areas where the BOH may require additional well testing, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-14.

(2) In addition to the town of Falmouth BOH regulations, which generally applies to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the Ashumet Valley contaminated groundwater for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy.

This LUC applies to both onbase and off-base portions of Ashumet Valley. The Air Force has provided municipal water supply hook-ups for all residences in areas of current or anticipated groundwater contamination. In conjunction with the Falmouth BOH Water Well Regulations, the municipal water supply hook-ups significantly reduce the likelihood of exposure to contaminated groundwater from existing wells and from any future wells installed in areas of anticipated contamination. Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

- (1) For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and USCG (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
- (2) For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the USCG by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging, or subsurface soil disturbance activity. All such permits are forwarded to the IRP for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).*
- (3) The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the Ashumet Valley groundwater area and to protect monitoring wells and the treatment system's infrastructure. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The Ashumet Valley groundwater plume is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Falmouth BOH, and the MassDEP in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or the treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of the Ashumet Valley plume. The extent of the Air Force's enforcement of this LUC does not address off-base parties failing to file a Dig Safe request nor Dig Safe improperly processing a notification, but if incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage cause by third parties to the remedial system infrastructure or monitoring wells.*

The LUCs are intended to prevent exposure to groundwater impacted by the Ashumet Valley plume; however, to insure that the LUCs obtain the LUC performance objectives the Air Force will take the following action.

Within three years of the signing of the ROD, the Air Force shall:

- a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the Ashumet Valley plume.*
- b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the Ashumet Valley plume, or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the EPA, until the plume no longer presents a threat to that well as determined in coordination with EPA.*
- c. If the Air Force identifies a well containing COCs, the Air Force shall assess the risk that current and potential future non-drinking uses of such a well pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and approval.*
- d. If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate BOH. If the decommissioning is not accepted, the Air Force will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the Ashumet Valley plume having carcinogens in excess of ARARs (i.e., MCLs, non-zero MCLGs), and prevent exposure to groundwater from the Ashumet Valley plume that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic HI greater than one.*

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (i) whether the use restrictions and controls referenced above were effectively communicated; (ii) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property; and (iii) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUC objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUC objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

For the LUCs identified and selected for this ROD, the Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the Ashumet Valley groundwater area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the Ashumet Valley plume area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Air Force will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining LUCs which may affect Ashumet Valley.

A.2 CHEMICAL SPILL-4

A description of the selected remedy for the Chemical Spill-4 (CS-4) plume as specified in the CS-4 ROD (AFCEE 2000c) is as follows (in italics):

Alternative 6: Three New Extraction Wells, Expanded Treatment Capacity in Combination with CS-20 Plume Treatment

- *This alternative includes continued operation of the existing CS-4 treatment system. If additional treatment capacity is required, water would be piped to the proposed treatment plant for the CS-20 plume. Extracted groundwater would be treated with granular-activated carbon. Plume contaminants would be destroyed during reactivation of the carbon.*
- *New extraction wells would be drilled to more effectively capture plume contamination. Water would be extracted along the axis of the plume and discharged to the aquifer in infiltration galleries. Existing extraction wells would no longer be used. Modeling indicates that the CS-4 plume can be hydraulically contained by capturing and treating 300 gallons per minute.*
- *Institutional controls, as discussed in Section 2.9.1, are included in this alternative.*
- *Operations and maintenance would continue until the three-step process outlined in Section 2.8.5 has been satisfied.*
- *Performance monitoring would consist of sampling existing monitoring wells and monitoring wells installed during system design. Sampling and analysis would be performed semiannually for the first two years and annually thereafter. Monthly influent, intermediate (between the carbon beds), and effluent samples would be required for both treatment systems. All samples will be analyzed for VOCs and EDB. A thorough site review would be conducted every five years until contaminant concentrations are below regulatory levels.*

2.9.1 Institutional Controls

Several institutional controls protect area residents from exposure to SWOU groundwater contaminants. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Residents and workers on MMR receive their water from the base water supply system. In addition, the drilling of a new drinking water supply well within the Crane Wildlife Management Area would require the approval of the Massachusetts Legislature. Thus, the institutional controls presently in place adequately prevent residential exposure in all Falmouth households currently connected to the municipal water supply and all residents and workers on MMR.

At its September 13, 1999 meeting, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. These regulations require a permit from the board to install a drinking water well. Drinking water wells in the Town of Falmouth must be tested for contamination, including VOCs and EDB. A drinking water well may not be used until the results of all required testing have been submitted and approved by the Board of Health.

If the Board of Health allows installation of a well above a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume, AFCEE would sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over a plume, within 500 feet cross-gradient of a plume, or 1500 feet downgradient of a plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies.

Institutional controls are already in place to prevent the drilling of private wells on the MMR. A lengthy review process must be completed before a public water supply well can be drilled on the military base. This process includes DEP review and ensures that wells will not be located in or immediately downgradient of known groundwater contamination plumes. Well construction in the area of the FS-13 plume would require permission of the Base Civil Engineer.

- Operations and maintenance would continue until a substantial portion of the plume mass has been extracted and influent concentrations have dropped to levels indicating that further system operation would produce minimal additional benefit.*
- This alternative would include performance, operational, and ecological monitoring. Performance monitoring would be conducted at monitoring wells to evaluate the effectiveness of the system at capturing plume contaminants. Performance sampling and analysis would be performed semiannually for the first two years and annually thereafter. Operational sampling would require monthly sampling of the influent, water collected between the carbon adsorbers, and the effluent. Samples would be analyzed for VOCs. Ecological monitoring would be conducted to determine the impact of the system on the ecology of downgradient surface water bodies. A thorough site review would be conducted every five years until contaminant concentrations are below regulatory levels.*

2.8.5 Steps to Achieving Remedial Action Objectives

MMR groundwater plumes, including the CS-4, CS-20, CS-21, and FS-13 plumes, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected (including those for the CS-4, CS-20, and CS-21 plumes), it will undertake a three-step process in achieving remedial action objectives. This three-step process, which was outlined in the Proposed Plan dated May 1999, will be implemented in the following manner:

- 1. **Remediate the aquifer to federal and state drinking water standards or other risk-based cleanup levels.** Restoration timeframes and remedial costs estimated in this ROD were developed based on the expected time to attain federal and state drinking water standards (MCLs and MMCLs) or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated). During the period that remedial systems are in operation, AFCEE will monitor the plume(s) in accordance with the approved system performance monitoring plan. The plume(s) will be considered to have reached MCLs, MMCLs or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated) when there have been no detections exceeding those levels over a time period agreed to by AFCEE and EPA in consultation with DEP.*
- 2. **When MCLs, MMCLs or other risk-based cleanup levels are achieved and before the system is shut off, perform a risk assessment to determine if unacceptable ecological and/or human health risks are present; continue system operation and/or pursue additional measures as required to achieve acceptable risks.** AFCEE shall conduct a risk assessment once MCLs, MMCLs or other risk-based cleanup levels have been achieved (as defined in step 1, above) to determine whether the contaminants of concern remaining in the aquifer continue to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly between AFCEE and EPA in consultation with DEP and may result in aquifer cleanup that is more protective than the NCP point of departure risk level of (40 CFR Part 300.430(e)(2)), if justified, based on the following site specific factors: “cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts” (NCP Preamble page 87 17).*
- 3. **Once acceptable risks have been achieved, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.** AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer.*

The feasibility of approaching or achieving background will be determined in accordance with the following criteria:

A. Technological - Not feasible if:

- i. The existing technologies or modifications cannot remediate to a level of no significant risk, or to levels which approach or achieve background; or*
- ii. The reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
- iii. The remedy does not or cannot be modified to meet other regulatory requirements.*

B. Economic - The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels which approach or achieve background justifies related cost unless:

- i. The incremental cost for the remedy is substantial and disproportional to the non-monetary values; or*
- ii. The risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA with input from DEP have also agreed that in the event that implementation of steps two and/or three above leads to a mutual decision to undertake additional cleanup and such decision results in a “significant” or “fundamental” change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an Explanation of Significant Differences (with public comment) or ROD Amendment, as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined jointly by AFCEE and EPA, in consultation with DEP, in accordance with the criteria set forth in EPA’s “A Guide to Preparing Superfund Proposed Plans, Records of Decision, And Other Remedy Selection Decision Documents,” OSWER 9200.1-23P (July 1999). In this manner, such changes will be subject to regulatory review and stakeholder involvement through issuance of a new proposed plan and/or conduct of a public comment period. In the event that a dispute arises regarding any of the determinations to be jointly reached under the three-step process outlined above, such dispute shall be resolved under the dispute resolution procedures of the MMR FFA. This three-step process has been agreed

to solely for groundwater cleanup at MMR due to unique circumstances presented by the location of the SWOU plumes within the sole-source aquifer on Upper Cape Cod.

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.3 CHEMICAL SPILL-10

A description of the selected remedy for the Chemical Spill-10 (CS-10) plume as specified in the CS-10 ROD (AFCEE 2009b) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE CS-10 GROUNDWATER OPERABLE UNIT (OU)

Based on the Administrative Record for the CS-10 site and the evaluation of comments received by stakeholders during the public comment period, AFCEE has selected a combination of Alternative 3 for the leading edge and Alternative 10 for the main body as the remedy for the CS-10 groundwater OU. Since the supplement to the FS addendum was completed, the Air Force has designed, constructed, and operated (initiated February 2009) the new extraction and reinjection wells represented by Alternative 10.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy (Alternative 3 for the leading edge and Alternative 10 for the main body) consists of continued operation of the existing CS-10 treatment systems (Sandwich Road, In-Plume, and NL) and the CS-10 SPEIM program, the installation of a new extraction well in the Southern Trench area and a new reinjection well northwest of the southern Sandwich Road extraction wells, and LTM and LUCs for the entire plume. The selected remedy is protective of human health through implementation of LUCs, complies with ARARs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame and is cost-effective.

2.11.2 Detailed Description of Selected Remedy

The selected remedy (Alternative 3 for the leading edge and Alternative 10 for the main body) consists of the existing optimized In-plume ETI system, NL ETR system, and the Sandwich Road ETR system with the system expanded into the Southern Trench area with

an additional extraction well and an additional reinjection well to improve capture of the plume in that area (Figure 2-8). The flow from the new extraction well will be treated at the SRTF and returned to the aquifer through the CS-10 and SD-5 reinjection wells. The flow to the new reinjection well will come from the CS-10 In-plume treatment facility via the Southern Infiltration Trench.

The ETR/ETI systems consist of ETR/ETI of groundwater following federal and state standards for TCE and PCE as stipulated in the current O&M plan. The alternative has the flexibility of modifying the treatment system to optimize the cleanup time frame and to insure it continues to meet performance objectives. Most likely, modifications would be executed with the existing extraction wells, reinjection wells, and infiltration trenches, and could involve the use of packers to reduce the effective vertical extent of the extraction screen, or adjusting flow rates. However, the alternative does not exclude the possibility of adding additional system components, if deemed necessary. Modifications would be made for the purpose of improving treatment system operation and expediting the plume cleanup.

This alternative would provide for chemical and hydraulic monitoring of the plume, as long as active remediation continues, and chemical monitoring of the plume until the RAOs are met. Monitoring data would aid in ongoing optimization and could prompt additional action if COC concentrations did not decrease as expected. Monitoring results will be periodically reported in formal reports. CERCLA reviews would be performed every five years throughout the lifetime of the alternative. A residual risk assessment and/or an evaluation of the technical and economic feasibility of additional remediation to approach background concentrations would be performed, if deemed necessary. The selected remedy also includes implementation of LUCs.

The following text describes the LUCs that will be implemented for the CS-10 groundwater selected remedy. The CS-10 contaminated groundwater currently poses an unacceptable risk to human health if used for household purposes (i.e., ingestion, dermal contact, and inhalation of vapors released during household use of water).

The CS-10 contaminated groundwater is located in the southern part of the MMR cantonment area and a portion of the contaminated groundwater has migrated past the MMR boundary into the neighboring towns of Falmouth and Mashpee. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as “LUCs,” must be established for the CS-10 groundwater to avoid the risk of exposure to CS-10 groundwater. These LUCs are needed both on-base and off-base, within the towns of Falmouth and Mashpee, until the CS-10 contaminated groundwater no longer poses an unacceptable risk.

The performance objectives of the LUCs are to:

- Prevent access to or use of the groundwater from the CS-10 contaminated groundwater until the groundwater no longer poses an unacceptable risk, and*
- Maintain the integrity of the current or future remedial or monitoring system such as the treatment systems and monitoring wells.*

The LUCs will encompass the area including the CS-10 contaminated groundwater and surrounding areas to reduce the risk from exposure to contaminated groundwater (Figure 2-8). The on-base area of concern is controlled and operated by the USCG, Army, and Air Force, who lease this land from the Commonwealth of Massachusetts. It is expected that these entities (USCG, U.S. Army, and U.S. Air Force) will control the on-base area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of COCs in the groundwater are at such levels as to allow unrestricted use and exposure, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following three LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. The Town of Falmouth has enforcement authority of the first LUC. The Town of Mashpee has enforcement authority of the second LUC. The Commonwealth of Massachusetts only has enforcement authority regarding the third LUC. In the event that the Town of Falmouth fails to promptly enforce the first LUC and/or the Town of Mashpee fails to promptly enforce the second LUC, or the Commonwealth of Massachusetts fails to promptly enforce the third LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e., the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

- 1) The Falmouth BOH requires a permit for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. If a permit to install a drinking water well is approved, the Falmouth BOH will not approve the use of that well until its water has been tested and the BOH has determined that the water is potable. The Falmouth BOH Water Well Regulations do not apply to use of existing drinking water wells and irrigation wells. The regulations, which are reproduced in Appendix C, include documented and anticipated areas of contamination from the CS-10 plume. To assist the Town of Falmouth in the implementation of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the CS-10 plume within the town of Falmouth. While Figure 2-8 shows the current area of LUCs in the town, the Falmouth BOH may modify the areas where the BOH may require additional well testing, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-8.*
- 2) To better protect the public health and welfare of its citizens, the Mashpee BOH, adopted a moratorium on residential wells on 23 April 1998, amended 29 July 1999, in the town of Mashpee. The moratorium, as amended, applies to existing wells and potential future wells, and restricts any and all uses of groundwater (Appendix D). The areas where well use is excluded are defined by the Mashpee BOH, and include documented areas of contamination and anticipated areas of contamination from the CS-10 contaminated groundwater. To assist the Mashpee BOH in the implementation of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the CS-10 contaminated groundwater within the town of Mashpee. While Figure 2-8 shows the current area of LUCs in the town, the*

Mashpee BOH may modify the areas subject to the moratorium or where the BOH may require additional well testing, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-8.

- 3) In addition to the towns of Falmouth and Mashpee BOH regulations, which generally apply to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the CS-10 contaminated groundwater for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy. This LUC applies to both onbase and off-base portions of CS-10.*

The Air Force has provided municipal water supply hook-ups for all residences in areas of current or anticipated groundwater contamination. In conjunction with the Falmouth and Mashpee BOH regulations, the municipal water supply hook-ups significantly reduce the likelihood of exposure to contaminated groundwater from existing wells and from any future wells installed in areas of anticipated contamination. Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

- (1) For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and USCG (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
- (2) For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the USCG by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging, or subsurface soil disturbance activity. All such permits are forwarded to the IRP for concurrence before issuance.*

An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).

- (3) The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the CS-10 groundwater area and to protect monitoring wells and the treatment system's infrastructure. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The CS-10 groundwater plume is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Falmouth BOH or the Mashpee BOH, and the MassDEP in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or the treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of the CS-10 plume. The extent of the Air Force's enforcement of this LUC does not address off-base parties failing to file a Dig Safe request nor Dig Safe improperly processing a notification, but if incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the remedial system infrastructure or monitoring wells.*

The LUCs are intended to prevent exposure to groundwater impacted by the CS-10 plume; however, to insure that the LUCs obtain the LUC performance objectives the Air Force will take the following action.

Within three years of the signing of the ROD, the Air Force shall:

- a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the CS-10 plume.*
- b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the CS-10 plume, or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the EPA, until the plume no longer presents a threat to that well as determined in coordination with EPA.*
- c. If the Air Force identifies a well containing COCs, the Air Force shall assess the risk that current and potential future non-drinking uses of such a well pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and approval.*

- d. *If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate BOH. If the decommissioning is not accepted, the Air Force will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the CS-10 plume having carcinogens in excess of ARARs (i.e., MCLs, non-zero MCLGs), and prevent exposure to groundwater from the CS-10 plume that poses a cancer risk in excess of the EPA target risk range of 10⁻⁴ to 10⁻⁶ or which presents a non-carcinogenic HI greater than one.*

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (1) whether the use restrictions and controls referenced above were effectively communicated, (2) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property, and (3) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUCs objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUCs objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after

the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUCs objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

For the LUCs identified and selected for this ROD, the Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the CS-10 groundwater area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the CS-10 plume area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Air Force will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining LUCs which may affect CS-10.

A.4 CHEMICAL SPILL-19

A description of the selected remedy for the Chemical Spill-19 (CS-19) plume as specified in the CS-19 ROD (AFCEE 2009a) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE CS-19 GROUNDWATER OPERABLE UNIT (OU)

Based on the Administrative Record for the CS-19 site and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 2 as the remedy for the CS-19 groundwater.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 2, which consists of monitored natural attenuation with LUCs. A full description of the preferred remedy is provided below. The selected remedy provides a means of verifying the natural attenuation of the groundwater contamination through monitoring, is protective of human health through implementation of LUCs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame and is cost-effective.

Monitored natural attenuation is an appropriate remedy based on the following:

- The source of the CS-19 plume has been removed;*
- RDX concentrations in groundwater beneath the source area have decreased, indicating there is no significant amount of mass being contributed to the plume;*
- The CS-19 plume is predicted to migrate downgradient of its current position at low concentrations (up to 2 µg/L) but the mass and volume of the plume are not predicted to increase significantly;*
- The CS-19 plume is not predicted to migrate past the MMR boundary;*
- RDX in groundwater can be effectively remediated by natural attenuation processes;*
- The conditions in the aquifer are not anticipated to change over time;*
- Drinking water supplies will not be adversely affected by selecting MNA because the*

downgradient drinking water supplies are already considered not useable due to potential impacts from the Bourne Integrated Solid Waste Facility;

- *There are no currently available water supplies that will be impacted by the plume;*
- *The plume is not predicted to discharge to any surface water bodies and thus will not exert a long-term detrimental impact on environmental resources;*
- *The estimated timeframe of remediation is reasonable (2037) compared to the active treatment alternative (2030);*
- *The daughter products of RDX degradation will not cause a greater risk than the RDX contamination; and*
- *There are existing LUCs that prevent exposure to the CS-19 plume and AFCEE is responsible for monitoring the enforcement of the LUCs.*

2.11.2 Detailed Description of Selected Remedy

AFCEE has developed a monitoring plan for the CS-19 groundwater that will include data from a network of monitoring wells. Additional monitoring wells may be installed to track the plume movement. The monitoring wells will be sampled for RDX. Periodic monitoring results will be reported in a letter report. Evaluation of all analytical results will include tracking the natural attenuation of the CS-19 groundwater contamination. AFCEE, in consultation with the regulatory agencies, will develop a comprehensive long term monitoring plan considering the guidance provided in Office of Solid Waste and Emergency Response Directive 9200.4-17P (Apr. 21, 1999) titled Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (EPA 1999a). The monitoring plan itself will be reviewed periodically for adequate coverage of the area and optimization potential. Monitoring will continue for two years beyond the time at which RDX concentrations decrease below 0.6 µg/L. CERCLA five-year reviews will be performed to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use levels in the groundwater. As long as five-year reviews are required, as part of each such five-year review the Air Force will evaluate the attenuation of the plume as compared to the modeled predictions used in developing this ROD. If this analysis or any other information brought to the Air Force's attention indicates that the attenuation of the plume is significantly different from predicted, the Air Force will re-evaluate the plume

through use of a combination of monitoring well data and groundwater modeling and propose an appropriate course of action. A residual risk assessment and/or an evaluation of the technical and economic feasibility of additional remediation to approach or achieve background concentrations would be conducted if deemed necessary.

The CS-19 source area resulting from the disposal of munitions was addressed through a removal action (AFCEE 2009a, b, ECC 2008) conducted with regulator concurrence. The removal action applied the MCP S-1/GW-1 RDX cleanup standard of 1,000 µg/kg for the CS-19 source area. After the removal action was complete the maximum RDX concentration in soil was 940 µg/kg in one part of one grid. The confirmatory sample results for the majority of the other grids were nondetect. EPA and MassDEP agree that the actual confirmatory levels are protective and that any leaching to groundwater would be well below risk-based levels. The effectiveness of the source removal will also be evaluated through review of the groundwater data beneath the source as part of the evaluation of the natural attenuation of the plume. If the groundwater plume attenuation is significantly different from predicted, the Air Force will re-evaluate the source area and propose an appropriate course of action.

The groundwater from the CS-19 plume currently poses an unacceptable risk to human health if used for drinking water purposes. The CS-19 plume is located on the MMR within the Upper Cape Water Supply Reserve, which includes the Camp Edwards Training Area, and is not expected to migrate past the MMR boundary. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as LUCs must be established for this area of concern, in this case to avoid risk of exposure to groundwater in the CS-19 area. These LUCs are needed until the groundwater from the CS-19 contaminated groundwater no longer poses an unacceptable risk.

The performance objectives of the LUCs are:

- *Prevent access to or use of the groundwater from the CS-19 plume area until the groundwater no longer poses an unacceptable risk , and*
- *Maintain the integrity of any current or future groundwater monitoring system.*

The LUCs will encompass the area including the CS-19 contaminated groundwater and surrounding areas to reduce the risk from exposure to contaminated groundwater (Figure 2-7). The area of concern and surrounding area is controlled and operated by the U.S. Department of the Army, which leases this land from the Commonwealth of Massachusetts. It is expected that these entities will operate and own, respectively, the area of concern and the surrounding area for the duration of the ROD. As a result, the Air Force must develop and coordinate the LUCs for this site with these entities, as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of RDX in the groundwater are at such levels as to allow unrestricted use and exposure, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following LUC is established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. In the event the Commonwealth fails to promptly enforce this LUC the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e., the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

(1) The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the CS-19 contaminated groundwater for any withdrawals of groundwater for drinking water purposes, constitutes a LUC for this final remedy.

Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

(1) A prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and USCG (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.

(2) The Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the USCG by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging, or subsurface soil disturbance activity. All such permits are forwarded to the IRP for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).

(3) The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the CS-19 groundwater area and to protect monitoring wells. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The CS-19 groundwater plume is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, and the MassDEP in order to curtail

the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or the treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. The extent of the Air Force's enforcement of this LUC does not address Dig Safe improperly processing a notification, but if incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the monitoring wells.

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The results will be included in a report and provided to the EPA and MassDEP for informational purposes. The reports will be used in preparation of the five year review to evaluate the effectiveness of the final remedy.

The annual report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (1) whether the use restrictions and controls referenced above were effectively communicated, (2) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property, and (3) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUCs objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUCs objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUCs objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

For the LUCs identified and selected for this ROD, the Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the CS-19 groundwater area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the CS-19 plume area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Air Force will provide EPA and MassDEP 30 day's notice of any changes to the internal procedures for maintaining LUCs which may affect CS-19.

A.5 CHEMICAL SPILL-20

A description of the selected remedy for the Chemical Spill-20 (CS-20) plume as specified in the CS-20 ROD (AFCEE 2000c) is as follows (in italics):

Alternative 5: Extraction, Treatment with Granular-Activated Carbon and Reinjection for Plume Capture

- *Under this alternative, an ETR system would be constructed to capture and treat plume contaminants. Extracted water would be treated with granular-activated carbon. Contaminants would be destroyed during carbon reactivation. Pretreatment to remove iron and manganese from the groundwater may be required. The need for pretreatment would be reviewed during the design phase. If the need for pretreatment is still questionable at that point, the system would be constructed without pretreatment, and a pretreatment system would be installed at a later date, if it proved to be an operational necessity or if it appeared to reduce lifecycle costs.*
- *The ETR system would be designed to hydraulically contain the plume. Water would be extracted through extraction wells and discharged to the aquifer in infiltration galleries. Groundwater modeling indicates that hydraulic containment can be accomplished by pumping and treating approximately 500 gallons per minute along the axis of the plume.*
- *Institutional controls, as discussed in Section 2.9.1, are included in this alternative.*
- *Operations and maintenance would continue until the three-step process outlined in Section 2.8.5 has been satisfied.*
- *Also included in this alternative are long-term monitoring of the plume, performance monitoring and evaluation of the treatment systems, and ecological sampling to monitor the impacts of the systems on the environment. The long-term monitoring program would consist of sampling and analysis at monitoring wells within the body of the plume, downgradient of the plume, and to either side of the plume. Operational monitoring would require monthly sampling of influent, effluent and water collected between carbon vessels. Additionally, samples would be collected from each extraction well twice each year. All samples would be analyzed for VOCs and EDB. A thorough site review would be conducted every five years until contaminant concentrations are below regulatory levels.*

2.9.1 Institutional Controls

Several institutional controls protect area residents from exposure to SWOU groundwater contaminants. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Residents and workers on MMR receive their water from the base water supply system. In addition, the drilling of a new drinking

water supply well within the Crane Wildlife Management Area would require the approval of the Massachusetts Legislature. Thus, the institutional controls presently in place adequately prevent residential exposure in all Falmouth households currently connected to the municipal water supply and all residents and workers on MMR.

At its September 13, 1999 meeting, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. These regulations require a permit from the board to install a drinking water well. Drinking water wells in the Town of Falmouth must be tested for contamination, including VOCs and EDB. A drinking water well may not be used until the results of all required testing have been submitted and approved by the Board of Health.

If the Board of Health allows installation of a well above a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume, AFCEE would sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over a plume, within 500 feet cross-gradient of a plume, or 1500 feet downgradient of a plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies.

Institutional controls are already in place to prevent the drilling of private wells on the MMR. A lengthy review process must be completed before a public water supply well can be drilled on the military base. This process includes DEP review and ensures that wells will not be located in or immediately downgradient of known groundwater contamination plumes. Well construction in the area of the FS-13 plume would require permission of the Base Civil Engineer.

2.8.5 Steps to Achieving Remedial Action Objectives

MMR groundwater plumes, including the CS-4, CS-20, CS-21, and FS-13 plumes, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected (including those for the CS-4, CS-20, and CS-21 plumes), it will undertake a three-step process in achieving remedial action objectives. This three-step process, which was outlined in the Proposed Plan dated May 1999, will be implemented in the following manner:

- 1. **Remediate the aquifer to federal and state drinking water standards or other risk-based cleanup levels.** Restoration timeframes and remedial costs estimated in this ROD were developed based on the expected time to attain federal and state drinking water standards (MCLs and MMCLs) or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated). During the period that remedial systems are in operation, AFCEE will monitor the plume(s) in accordance with the approved system performance monitoring plan. The plume(s) will be considered to have reached MCLs, MMCLs or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated) when there have been no detections exceeding those levels over a time period agreed to by AFCEE and EPA in consultation with DEP.*
- 2. **When MCLs, MMCLs or other risk-based cleanup levels are achieved and before the system is shut off, perform a risk assessment to determine if unacceptable ecological and/or human health risks are present; continue system operation and/or pursue additional measures as required to achieve acceptable risks.** AFCEE shall conduct a risk assessment once MCLs, MMCLs or other risk-based cleanup levels have been achieved (as defined in step 1, above) to determine whether the contaminants of concern remaining in the aquifer continue to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly between AFCEE and EPA in consultation with DEP and may result in aquifer cleanup that is more protective than the NCP point of departure risk level of (40 CFR Part 300.430(e)(2)), if justified, based on the following site specific factors: “cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts” (NCP Preamble page 8717).*
- 3. **Once acceptable risks have been achieved, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.** AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:*

- A. *Technological - Not feasible if:*
 - i. *The existing technologies or modifications cannot remediate to a level of no significant risk, or to levels which approach or achieve background; or*
 - ii. *The reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
 - iii. *The remedy does not or cannot be modified to meet other regulatory requirements.*
- B. *Economic - The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels which approach or achieve background justifies related cost unless:*
 - i. *The incremental cost for the remedy is substantial and disproportional to the benefit of risk reduction, environmental restoration and monetary and non-monetary values; or*
 - ii. *The risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA with input from DEP have also agreed that in the event that implementation of steps two and/or three above leads to a mutual decision to undertake additional cleanup and such decision results in a “significant” or “fundamental” change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an Explanation of Significant Differences (with public comment) or ROD Amendment, as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined jointly by AFCEE and EPA, in consultation with DEP, in accordance with the criteria set forth in EPA’s “A Guide to Preparing Superfund Proposed Plans, Records of Decision, And Other Remedy Selection Decision Documents,” OSWER 9200.1-23P (July 1999). In this manner, such changes will be subject to regulatory review and stakeholder involvement through issuance of a new proposed plan and or conduct of a public comment period. In the event that a dispute arises regarding any of the determinations to be jointly reached under the three-step process outlined above, such dispute shall be resolved under the dispute resolution procedures of the MMR FFA. This three-step process has been agreed to solely for groundwater cleanup at MMR due to unique circumstances presented by the location of the SWOU plumes within the sole-source aquifer on Upper Cape Cod.

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.6 CHEMICAL SPILL-21

A description of the selected remedy for the Chemical Spill-21 (CS-21) plume as specified in the CS-21 ROD (AFCEE 2000c) is as follows (in italics):

Alternative 11: Extraction, Treatment, and Reinjection for Expedited Cleanup

- *As conceptually designed, this alternative would include two ETR systems to remediate the CS-21 plume. Water extracted by both systems would be treated with granular-activated carbon. One large, aboveground system would treat the bulk of plume contaminants; a smaller below ground system would treat the distal end of the plume. Contaminants would be destroyed during carbon regeneration.*
- *This system would hydraulically capture the CS-21 plume. Contaminated groundwater would be extracted with extraction wells located along the axis of the plume. Water treated at the larger system would be returned to the aquifer in infiltration galleries. Water treated at the smaller system would be discharged in a reinjection well. (Modeled system flow rate was 1400 gallons per minute.)*
- *Institutional controls, as discussed in Section 2.9.1, are included in this alternative.*
- *Operations and maintenance would continue until the three-step process outlined in Section 2.8.5 has been satisfied.*
- *Monitoring would include three components: performance monitoring, operational monitoring, and ecological monitoring. Performance monitoring would include the collection of samples from monitoring wells to assess the systems' ability to capture plume contaminants. Operational monitoring would require monthly sampling of the influent, water collected between the carbon adsorbers, and the effluent. Samples would be analyzed for VOCs. Monitoring well sampling and analysis would be performed semiannually for the first two years and annually thereafter. Ecological monitoring would be conducted to assess the impact of the treatment system on the ecology of downgradient surface water bodies. A thorough site review would be conducted every five years until contaminant concentrations are below regulatory levels.*

2.9.1 Institutional Controls

Several institutional controls protect area residents from exposure to SWOU groundwater contaminants. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Residents and workers on MMR receive their water from the base water supply system. In addition, the drilling of a new drinking water supply well within the Crane Wildlife Management Area would require the approval of the Massachusetts Legislature. Thus, the institutional controls presently in

place adequately prevent residential exposure in all Falmouth households currently connected to the municipal water supply and all residents and workers on MMR.

At its September 13, 1999 meeting, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. These regulations require a permit from the board to install a drinking water well. Drinking water wells in the Town of Falmouth must be tested for contamination, including VOCs and EDB. A drinking water well may not be used until the results of all required testing have been submitted and approved by the Board of Health.

If the Board of Health allows installation of a well above a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume, AFCEE would sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over a plume, within 500 feet cross-gradient of a plume, or 1500 feet downgradient of a plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies.

Institutional controls are already in place to prevent the drilling of private wells on the MMR. A lengthy review process must be completed before a public water supply well can be drilled on the military base. This process includes DEP review and ensures that wells will not be located in or immediately downgradient of known groundwater contamination plumes. Well construction in the area of the FS-13 plume would require permission of the Base Civil Engineer.

2.8.5 Steps to Achieving Remedial Action Objectives

MMR groundwater plumes, including the CS-4, CS-20, CS-21, and FS-13 plumes, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected (including those for the CS-4, CS-20, and CS-21 plumes), it will undertake a three-step process in achieving remedial action objectives. This three-

step process, which was outlined in the Proposed Plan dated May 1999, will be implemented in the following manner:

1. **Remediate the aquifer to federal and state drinking water standards or other risk-based cleanup levels.** Restoration timeframes and remedial costs estimated in this ROD were developed based on the expected time to attain federal and state drinking water standards (MCLs and MMCLs) or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated). During the period that remedial systems are in operation, AFCEE will monitor the plume(s) in accordance with the approved system performance monitoring plan. The plume(s) will be considered to have reached MCLs, MMCLs or other risk-based cleanup levels (for those contaminants for which no MCLs or MMCLs are promulgated) when there have been no detections exceeding those levels over a time period agreed to by AFCEE and EPA in consultation with DEP.
2. **When MCLs, MMCLs or other risk-based cleanup levels are achieved and before the system is shut off, perform a risk assessment to determine if unacceptable ecological and/or human health risks are present; continue system operation and/or pursue additional measures as required to achieve acceptable risks.** AFCEE shall conduct a risk assessment once MCLs, MMCLs or other risk-based cleanup levels have been achieved (as defined in step 1, above) to determine whether the contaminants of concern remaining in the aquifer continue to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly between AFCEE and EPA in consultation with DEP and may result in aquifer cleanup that is more protective than the NCP point of departure risk level of (40 CFR Part 300.430(e)(2)), if justified, based on the following site specific factors: “cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts” (NCP Preamble page 8717).
3. **Once acceptable risks have been achieved, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.** AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:
 - A. *Technological - Not feasible if:*
 - i. *The existing technologies or modifications cannot remediate to a level of no significant risk, or to levels which approach or achieve background; or*
 - ii. *The reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
 - iii. *The remedy does not or cannot be modified to meet other regulatory requirements.*

- B. Economic - The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels which approach or achieve background justifies related cost unless:*
- i. The incremental cost for the remedy is substantial and disproportional to the benefit of risk reduction, environmental restoration and monetary and non-monetary values; or*
 - ii. The risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA with input from DEP have also agreed that in the event that implementation of steps two and/or three above leads to a mutual decision to undertake additional cleanup and such decision results in a “significant” or “fundamental” change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an Explanation of Significant Differences (with public comment) or ROD Amendment, as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined jointly by AFCEE and EPA, in consultation with DEP, in accordance with the criteria set forth in EPA’s “A Guide to Preparing Superfund Proposed Plans, Records of Decision, And Other Remedy Selection Decision Documents,” OSWER 9200.1-23P (July 1999). In this manner, such changes will be subject to regulatory review and stakeholder involvement through issuance of a new proposed plan and or conduct of a public comment period. In the event that a dispute arises regarding any of the determinations to be jointly reached under the three-step process outlined above, such dispute shall be resolved under the dispute resolution procedures of the MMR FFA. This three-step process has been agreed to solely for groundwater cleanup at MMR due to unique circumstances presented by the location of the SWOU plumes within the sole-source aquifer on Upper Cape Cod.

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.7 CHEMICAL SPILL-23

A description of the selected remedy for the Chemical Spill-23 (CS-23) plume as specified in the CS-23 ROD (AFCEE 2007b) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE CS-23 GROUNDWATER OPERABLE UNIT

Based on the Administrative Record for CS-23 and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 3 as the remedy for the CS-23 groundwater OU. Since the FS was completed, the Air Force has designed, constructed, and operated (initiated December 2006) the CS-23 base boundary ETI system represented by Alternative 3.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 3, which consists of continued operation and optimization of the existing ETI system, monitoring, and LUCs. The selected remedy provides for treatment of the plume via the existing ETI system, is protective of human health through implementation of LUCs, complies with ARARs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame and is cost-effective (the base boundary ETI system is estimated to operate for five years). The preferred remedy is expected to achieve RAOs within approximately 42 years for the entire plume but most of the plume will achieve RAOs well before that time. Leading edge capture was not deemed necessary because the uncaptured plume mass is expected to decrease below the MCL before migrating significantly downgradient; modeling predicts above-MCL concentrations would not migrate west of Route 28.

2.11.2 Detailed Description of Selected Remedy

The selected remedy would provide for continued active treatment of the CS-23 plume with the current ETI system, which extracts groundwater via two extraction wells, the water is then pumped to the Hunter Avenue Treatment Facility where it is treated using

GAC, and then returned to the aquifer by means of two infiltration trenches. The objective of this alternative would be to continue to expedite aquifer restoration through use of the existing ETI system. The ETI system consists of extraction, treatment, and infiltration of groundwater following federal and state standards for the CS-23 COCs, which will be stipulated in the updated O&M plan. The remedy leaves open the possibility of modifying the treatment system to optimize the cleanup time frame. Most likely, modifications would be implemented using the existing extraction and infiltration trenches and could involve well packering, turning on or off existing extraction wells, or adjusting flow rates. This remedy, however, does not exclude the possibility of adding system components, such as additional extraction wells, if deemed necessary. Modifications could be made for the purpose of improving treatment system operation and expediting plume cleanup.

This remedy would also provide for chemical and hydraulic monitoring of the plume as long as active remediation continued and for chemical monitoring until the RAOs are met. Sensitive wetlands in the area (i.e., Vernal Pool #651, Spectacle Wetland, Spit Pond, Osborn Pond, and Edmunds Pond) (AFCEE 2006a) will be hydraulically monitored to ensure no ecological thresholds are exceeded through operation of the CS-23 ETI system. Monitoring data would aid in ongoing optimization and could prompt additional action if COC concentrations did not decrease as expected. Monitoring results will be periodically reported in formal reports. CERCLA reviews will be performed every five years to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use levels in the groundwater. A residual risk assessment would be conducted, if deemed necessary, and would likely include additional data collection and analysis.

Groundwater from the CS-23 plume currently poses an unacceptable risk to human health if used for household purposes (i.e., ingestion, dermal contact, and inhalation of vapors released during household use of water). The CS-23 plume is located in the southwest part of the MMR, and a portion of the CS-23 plume has migrated past the MMR boundary into the neighboring town of Falmouth. Therefore, administrative

and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use (i.e., LUCs) have been established for this area of concern to avoid the risk of exposure to groundwater from the CS-23 area. These LUCs are needed both on-base and off-base, within the town of Falmouth, until the groundwater from the CS-23 plume no longer poses an unacceptable risk.

The performance objectives of the LUCs are:

- Prevent access to or use of the groundwater from the CS-23 plume until the groundwater no longer poses an unacceptable risk; and*
- Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.*

The LUCs will encompass the area including the CS-23 plume (Figure 2-5) and surrounding areas to reduce potential exposure to the plume. The on-base area of concern is controlled and operated by the USCG and the Air Force, who lease this land from the Commonwealth of Massachusetts. It is expected that these entities (USCG and U.S. Air Force) will control the area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of TCE and CCl₄ in the groundwater are at such a level to allow unrestricted use and exposure, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following two LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. The Commonwealth of Massachusetts only has enforcement authority regarding the second LUC. In the event that the Town of Falmouth fails to promptly enforce the first LUC or the Commonwealth of Massachusetts

fails to promptly enforce the second LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e., the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

- 1. The Falmouth BOH requires a permit for the installation and use of new wells, including drinking water wells, irrigation wells, and monitoring wells. If a permit to install a drinking water well is approved, the Falmouth BOH will not approve the use of that well until its water has been tested and the BOH has determined that the water is potable. The Falmouth BOH Water Well Regulations do not apply to use of existing drinking water wells and irrigation wells. The regulations, which are reproduced in Appendix C, cover documented and anticipated areas of contamination from the CS-23 plume. To assist the Town of Falmouth in the implementation of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the CS-23 plume within the town of Falmouth. While Figure 2-5 shows the current area of LUCs in the town, the Falmouth BOH may modify the areas where well use is excluded, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-5.*
- 2. In addition to the BOH regulations, which generally apply to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the CS-23 plume for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy. This LUC applies to both on-base and off-base portions of CS-23.*

The Air Force has provided municipal water supply hook-ups for all residences in areas of current or anticipated groundwater contamination. In conjunction with the Falmouth BOH Well Regulations, the municipal water supply hook-ups significantly reduce the likelihood of exposure to contaminated groundwater from existing wells and from any future wells installed in areas of anticipated contamination. Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

1. *For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guards and USCG (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
2. *For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the USCG by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging or subsurface soil disturbance activity. All such permits are forwarded to the IRP for review before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).*
3. *The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the CS-23 area and to protect monitoring wells and the treatment system's infrastructure. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The CS-23 plume is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Falmouth BOH and the MassDEP, in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of CS-23. The extent of the Air Force's enforcement of this LUC does not address off-base parties failing to file a Dig Safe request nor Dig Safe improperly processing a notification, but if such incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the remedial system infrastructure or monitoring wells.*

The LUCs are intended to prevent exposure to groundwater impacted by the CS-23 plume; however, to insure that the LUCs obtain the LUC performance objectives the Air Force will take the following action.

Within three years of the signing of the ROD, the Air Force shall:

- a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the CS-23 plume.*
- b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the CS-23 plume, or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the EPA, until the plume no longer presents a threat to that well as determined in coordination with EPA.*
- c. If the Air Force identifies a well containing COCs, the Air Force shall assess the risk current and potential future non-drinking uses of such a well pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and approval.*
- d. If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate BOH. If the decommissioning is not accepted, the Air Force will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA approval, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the CS-23 plume having carcinogens in excess of ARARs (i.e., MCLs, non-zero maximum contaminant level goals), and prevent exposure to groundwater from the CS-23 plume that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic hazard index greater than one.*

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (i) whether the use restrictions and controls referenced above were effectively communicated, (ii) whether the operator, owner and state and local agencies were notified of the use restrictions and controls affecting the property, and (iii) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUC objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUC objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

For the LUCs identified and selected for this ROD, the Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the CS-23 area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implement actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the CS-23 area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Air Force will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining LUCs which may affect CS-23.

A.8 FUEL SPILL-1

A description of the selected remedy for the Fuel Spill-1 (FS-1) plume as specified in the FS-1 ROD (AFCEE 2000b) is as follows (in italics):

2.12 THE SELECTED REMEDY (ALERNATIVE 3B)

The chosen alternative is Alternative 3B, Axial and Leading Edge Extraction, Treatment, and ReInjection/Discharge. Alternative 3B includes:

- *Additional modeling to optimize the extraction system.*
- *Sampling and analysis to verify the boundaries of contamination that exceeds the MCLs. Additional bounding wells will be installed.*
- *Acquisition of property necessary to the extraction wells will be acquired. Acquisition may be through lease or purchase.*
- *Site preparation by constructing road(s) along the proposed path of extraction wells. For cost purposes, it is assumed that 3 miles of gravel road will be created.*
- *Installation of power and well controls wiring along the roadway(s).*
- *Installation of 17 deep axial extraction wells pumping at approximately 400 gpm.*
- *Installation of one deep extraction well pumping at approximately 200 gpm.*
- *Installation of 135 shallow well points pumping a total of 400 gpm.*
- *Installation of 19 reinjection wells capable of injecting 200 gpm.*
- *Construction of a surface water discharge system capable of discharging 800 gpm to the bog area.*
- *Construction of berms to separate areas of upwelling contaminated groundwater from areas in the bog at which contaminated groundwater does not upwell.*
- *Construction of additional treatment facility capacity using activated carbon adsorption to create a treatment facility capable of treating 1,000 gpm.*
- *Operation and maintenance of the system for 7 years.*
- *Performance of an ecological sampling program to ensure that groundwater extraction, treatment and reinjection/discharge does not impact sensitive aquatic habitat.*
- *AFCEE will conduct a round of fish sampling in 2000 and 2001 as a measure of meeting the remedial action objective related to surface water. Identified objectives*

include evaluation of the fish ingestion pathway and determination of environmental impact on the fish in the surface water of the Quashnet River cranberry bog complex.

Construction activities associated with the Quashnet River Bogs Pilot Test are complete. Implementation of the axial well extraction system and enlargement of the treatment facility and discharge systems will begin within 15 months of signature of the final ROD.

Monitoring site conditions will involve collecting and analyzing groundwater and surface water samples. These site inspections, and the collection and analysis of groundwater and surface water samples, will be performed quarterly for the first 2 years and annually thereafter for 5 years. The sampling, analysis, data validation, and preparation of a monitoring report will require approximately 12 weeks per sampling event. Monitoring wells adequate for such monitoring exist at the AOC. Surface water will also be monitored. Additionally, wells in the source area will be resampled for metals and VOCs to verify the presence of VOCs and metals above background and MCLs. The monitoring program will involve groundwater and surface water sampling for EDB by USEPA Method 504, VOCs by USEPA Method 524, and metals by USEPA Method 200.7/6010/7000.

Institutional controls will be employed that include placing of zoning restrictions on the AOC to limit site activities. Identified restrictions include restrictions preventing use of impacted groundwater for 7 years. The leading edge extraction system is operational as the Quashnet River Bogs Pilot Test, and it is expected that surface contamination will be significantly reduced by April 2000. The authority for institutional controls for FS-1 involves on-base and off-base authorities. For source area groundwater, there is no immediate risk. Residents and workers on the base obtain drinking water from the base water supply system. Construction projects on MMR, including water supply wells, require written approval from the Base Civil Engineer. Construction of a new drinking water supply well for MMR would also require DEP permission. For downgradient groundwater, institutional controls have been enacted by the Town of Mashpee. Mashpee has placed a moratorium on wells impacted by contaminated groundwater.

2.12.1 Summary of the Rationale for the Selected Remedy (Alternative 3B)

Alternative 3B, Axial and Leading Edge Extraction, Treatment, and Reinjection/Discharge was selected as the remedy because that alternative best satisfies the threshold criteria, overall protection of Human Health and the Environment. A component of that alternative, “Leading Edge Extraction, Treatment and reinjection Discharge” is presently operating as the Quashnet River Bogs Pilot Test. Therefore, that system is already protecting human health by reducing releases of EDB into surface water.

Alternative 3B is considered the most protective of human health because of the combined utilization of leading edge extraction and axial extraction. The advantage of alternative 3B over Alternative 2B is the use of axial wells. Aquifer cleanup is more rapid using an axial well component and will extract a higher percentage of contamination. Alternative 3B is more protective than Alternative 3 because Alternative 3B incorporates leading edge extraction. Leading edge extraction is flexible and can be rapidly modified to address site conditions or to optimize performance. Additionally, because of the modular nature of leading edge extraction, a catastrophic failure of this system is less likely than a system proposed under Alternative 3 which relies exclusively on deep, high-production axial extraction wells. Portions of the leading edge extraction system can fail without seriously impacting the overall effectiveness of the extraction. Further more, the leading edge extraction system will act as a “safety net” since it is likely to capture any contamination that may escape the axial extraction system. Repair and maintenance of the leading edge extraction system is easier and quicker than repair of deep axial wells. The versatility of Alternative 3B enhances the protection of human health and the environment. Alternative 3B is the most reliable of evaluated alternatives.

All alternatives include monitoring of source area groundwater. This remedy is appropriate for the source area, because the contaminants contained in source area groundwater are not mobile and do not present a current threat to humans or the environment.

A.9 FUEL SPILL-12

A description of the selected remedy for the Fuel Spill-12 (FS-12) plume as specified in the FS-12 ROD (AFCEE 2006b) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE FS-12 GROUNDWATER OPERABLE UNIT

Based on the Administrative Record for the FS-12 site and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 3 as the remedy for the FS-12 groundwater OU.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 3, which consists of continued operation and optimization of the existing ETR system, monitoring, and LUCs. A full description of the selected remedy is provided below. The selected remedy provides for treatment of the plume via the existing ETR system, is protective of human health through implementation of LUCs, complies with ARARs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame (approximately 25 years) and is cost-effective.

2.11.2 Detailed Description of Selected Remedy

The selected remedy would provide for continued active treatment of the FS-12 plume with the current ETR system. The objective of this alternative would be to continue to expedite aquifer restoration through use of the existing ETR system. The ETR system consists of extraction, treatment, and reinjection of groundwater following federal and state standards for the FS-12 COCs as stipulated in the current O&M plan. The alternative leaves open the possibility of modifying the treatment system to optimize the cleanup time frame. Most likely, modifications would be implemented using the existing

extraction and reinjection wellfields and could involve well packering, turning on or off existing extraction and reinjection wells, or adjusting flow rates. This alternative, however, does not exclude the possibility of adding system components, such as additional extraction wells, if deemed necessary. Modifications could be made for the purpose of improving treatment system operation and expediting plume cleanup. This alternative would also provide for chemical and hydraulic monitoring of the plume as long as active remediation continued and for chemical monitoring until the RAOs are met. Monitoring data would aid in ongoing optimization and could prompt additional action if COC concentrations did not decrease as expected. Monitoring results will be periodically reported in formal reports. CERCLA five-year reviews will be performed to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use levels in the groundwater. A residual risk assessment would be conducted, if deemed necessary, and would likely include additional data collection and analysis.

Groundwater from the FS-12 plume currently poses an unacceptable risk to human health if used for household purposes (i.e., ingestion, dermal contact, and inhalation of vapors released during household use of water). The FS-12 plume is located in the eastern part of the MMR off Greenway Road, and a portion of the FS-12 plume has migrated past the MMR boundary into the neighboring town of Sandwich. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as “land use controls” (LUCs), must be established for this area of concern to avoid the risk of exposure to groundwater from the FS-12 area. These LUCs are needed both on-base and off-base, within the town of Sandwich, until the groundwater from the FS-12 plume no longer poses an unacceptable risk.

The performance objectives of the LUCs are:

- Prevent access to or use of the groundwater from the FS-12 plume until the groundwater no longer poses an unacceptable risk;*
- Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.*

The LUCs will encompass the area including the FS-12 plume (Figure 2-8) and surrounding areas to prevent a risk from exposure to the plume. The on-base area of concern is controlled and operated by the U.S. Army, which leases this land from the Commonwealth of Massachusetts. It is expected that these entities will operate and own, respectively, the area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of EDB and benzene in the groundwater are at such a level to allow unrestricted use and exposure, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following two LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. The Commonwealth of Massachusetts only has enforcement authority regarding the second LUC. In the event that the Town of Sandwich fails to promptly enforce the first LUC or the Commonwealth of Massachusetts fails to promptly enforce the second LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e., the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

- 1. To better protect the public health and welfare of its citizens, the Town of Sandwich Board of Health amended its private well regulations on 11 April 2005 to prohibit the construction of potable water supply wells for new buildings. For existing buildings, the Board of Health will not approve any new well to be used for human consumption until its water has been tested and the Board of Health has determined that the water is potable. The regulation, which is reproduced in Appendix C, covers documented and anticipated areas of contamination from the FS-12 plume. To assist the Town of*

Sandwich in the implementation of this LUC, the Air Force will meet with the Board of Health on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the FS-12 plume within the Town of Sandwich. While Figure 2-8 shows the current area of LUCs in the town, the Sandwich Board of Health may modify the areas where well use is excluded, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-8.

- 2. In addition to the Board of Health regulation, which generally applies to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the FS-12 plume for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy. This LUC applies to both on-base and off-base portions of FS-12.*

Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

- 1. For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and United States Coast Guard (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
- 2. For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the United States Coast Guard by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging or subsurface soil disturbance activity. All such permits are forwarded to the Installation Restoration Program for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).*
- 3. The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the FS-12 area and to protect monitoring wells and the treatment system's infrastructure. This program*

requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The FS-12 plume is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Sandwich Board of Health and the MassDEP, in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of FS-12. The extent of the Air Force's enforcement of this LUC does not address off-base parties failing to file a Dig Safe request nor Dig Safe improperly processing a notification, but if such incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the remedial system infrastructure or monitoring wells.

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (i) whether the use restrictions and controls referenced above were effectively communicated, (ii) whether the operator, owner and state and local agencies were notified of the use restrictions and controls affecting the property, and (iii) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUC objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent

with the LUC objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

For the LUCs identified and selected for this ROD, the Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the FS-12 area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the FS-12 area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs.

A.10 FUEL SPILL-13

A description of the selected remedy for the Fuel Spill-13 (FS-13) plume as specified in the FS-13 ROD (AFCEE 2000c) is as follows (in italics):

Alternative 2: Limited Action with Institutional Controls

- *This alternative includes no treatment components.*
- *No actions to hydraulically control the plume are included in this alternative. Plume contaminants are immobile.*
- *Institutional controls are already in place to prevent the drilling of private wells on the MMR. A lengthy review process must be completed before a public water supply well can be drilled on the military reservation. This process includes DEP review and ensures that wells will not be located in or immediately downgradient from known groundwater contamination plumes. MMR residents and workers are supplied with safe drinking water from the base water supply and distribution system. If the land above the FS-13 plume is transferred to another governmental agency in the future, existing property control procedures require that the new agency be notified of the contamination. If the land above the FS-13 plume were to be sold, the deed for the property would specifically discuss the contamination present at the time of sale and, if human health concerns remain, prohibit the development of groundwater resources through an easement or similar mechanism.*
- *This alternative does not include significant operations and maintenance activities.*
- *Monitoring would consist of sampling approximately one monitoring well (38MW0004) within the FS-13 plume to evaluate changes in fuel-related contamination over time. In addition, annual sampling would be conducted at two wells downgradient from the plume (38MW0007 and 38MW0020) to ensure that the plume is not migrating. Evaluation of data from these wells and others in and around the underlying CS-10 plume would be done annually to determine if changes to the monitoring scope are necessary. These monitoring activities will help to ensure that FS-13 plume contamination does not pose a risk to human health or the environment in the future. A thorough site review would be conducted every five years until contaminant concentrations are below regulatory levels.*

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.11 FUEL SPILL-28

A description of the selected remedy for the Fuel Spill-28 (FS-28) plume as specified in the FS-28 ROD (AFCEE 2000a) is as follows (in italics):

2.11 SELECTED REMEDIES

Alternative 3 is the selected remedy for the FS-28 plume. The selected remedy will take advantage of the naturally converging flow field surrounding the FS-28 plume to capture over 99 percent of the plume mass using the extraction, treatment, and discharge systems AFCEE has already implemented under interim actions. Together with institutional controls, maintenance of the wellhead treatment system for the CWSW, and the maintenance of the systems that ensure a safe water supply for agricultural users of water in the Coonamessett River valley, the remedy provides a comprehensive approach for the protection of human health and the environment. If these remedial systems were not operating, the plume would discharge to the Coonamessett River and surrounding bogs and pose unacceptable health risks to human and ecological receptors.

2.11.1 Selected Remedy for the FS-28 Plume

The selected remedy for the FS-28 plume is Alternative 3. This remedy includes the continued operation of the FS-28 treatment system, including the shallow well-points, and continued operation of the CWSW wellhead treatment system. Also included is continued maintenance of the earthen berms and vinyl sheet piles installed to separate the Coonamessett River from the surrounding cranberry bogs. Because several components of the selected remedy were installed as part of interim actions, the selected remedy may involve more engineering and construction work to upgrade the existing systems (particularly the treatment buildings and pipelines) to more permanent systems. Institutional controls and long-term monitoring of the treatment systems and the plume itself are also included in the selected remedy.

Water in the Coonamessett River and surrounding bogs is routinely monitored to evaluate surface water quality in the area of the cranberry crop, to appraise the performance of the existing treatment system, and to assess any ecological impacts that the treatment system may be having. Routine analysis of a surface water sample collected in a ditch next to the E3 Upper Baptiste Bog on 18 May 2000 indicated the presence of EDB (location 69SW2018, concentration 0.068 µg/L). Samples collected at this location in previous months did not contain detectable concentrations of EDB, but subsequent sampling and analysis confirmed the presence of EDB in the surface water. The Upper Baptiste Bog is located downgradient from the deep extraction well (EW-1) and upgradient from the shallow well-point extraction system. Water from the ditch discharges to the Coonamessett River. However, because of the relatively low concentration of EDB present in the ditch, the low flow rate of water discharging from the ditch, and the much higher flow rate within the Coonamessett River, no EDB has been detected in the river.

Because upwelling of EDB in this area was not occurring when alternatives for the FS-28 plume were evaluated during the Final FS-28 and FS-29 Groundwater Feasibility Study (AFCEE 2000d), this upwelling was not considered in the development of these alternatives. AFCEE, EPA, and DEP have agreed to the following steps to address the contamination: During the fall of 2000, after the cranberry crop from adjacent bogs is harvested, the FS-28 treatment system will be shut down to allow for hydraulic testing and additional monitoring. Data collected will be used to infer the three-dimensional capture zone for the system. While the system is off-line, samples will be collected from some of the shallow well-points and analyzed for the presence of EDB to better determine the areas of upwelling. The capture zone information and the analytical data will be used to optimize flow rates for the shallow well-points and the deep extraction well and, if appropriate, to justify an increase in the capacity of the treatment system. If optimization of the selected remedy is not sufficient to prevent continued releases of EDB to surface water and more substantial changes to the remedy are required (for example, installation of additional deep extraction wells), such changes would be accomplished

through an Explanation of Significant Differences or ROD amendment after full consultation with the public.

The performance monitoring data collected since the start-up of the shallow well-point extraction system indicate that the FS-28 treatment system is effective at preventing most of the plume from discharging to surface waters. Ethylene dibromide is the only contaminant of concern for the FS-28 plume, and the hydrologic data indicate that within 18 years the EDB concentrations within the plume will be below the cleanup level of 0.02 µg/L, and that the river will continue to contain non-detectable levels of EDB. A small dilute portion of the plume (less than 0.3 percent of the total plume mass) will remain uncaptured by the proposed remedy. This portion of the plume lies downgradient of the existing treatment system and north of Thomas B. Landers Road. It is migrating in the subsurface downgradient of the current extraction system and is expected to discharge farther downstream, but is expected to be undetectable when it does reach the river.

The extraction system is comprised of one deep extraction well (69EW0001) screened from 160 to 220 feet below the ground surface and a shallow well-point extraction system. The shallow well-point extraction system uses a vacuum extraction system to extract water from up to 204 well-points. Each well-point is constructed of 2-inch diameter steel pipe installed to a depth of 13 feet below ground surface with a 2.3-foot or 3.0-foot screen. The well-points are connected using a polyvinyl chloride (PVC) header system. Water from the deep well and the shallow well-point extraction system are combined in the treatment plant.

The treatment system is comprised of two 20,000-pound granular activated carbon vessels operating in series and has the capacity of treating 750 gallons per minute. (As the system is currently being operated, 400 gallons per minute are being extracted from the deep extraction well and 350 gallons per minute are being extracted from the shallow well-points.) Treatment system influent concentrations of EDB have dropped from almost 5 µg/L when the system first became operational in October 1997 to approximately 0.5 µg/L in the spring of 2000. Since EDB concentrations in the plume

decrease with upgradient distance from the extraction system, the influent concentrations will continue to decrease with time.

Under normal operation, treated water is discharged to surface water. Treated water flows through the effluent pipeline to a vertical riser called a bubbler, constructed of 18-inch corrugated metal pipe. The bubbler is designed to increase the levels of dissolved oxygen in the treated water. Water cascades out of the bubbler into the Coonamessett River. To ensure that clean water will be available for cranberry bog flooding, the discharge system was designed to allow treated water to be discharged at six alternate locations. Remote discharge is available through bubblers located in the Adams bog, Augusta bog, Augusta bog reservoir, Quanamet bog, Chaston bog, and the east Thompson bog. At the primary discharge location, treated water can also be directed to flow through the spray irrigation system for the adjacent cranberry bog.

Several institutional controls protect area residents from exposure to the FS-28 plume. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. In addition to the steps AFCEE has already taken to connect potentially affected residents to the municipal water supply, the Town of Falmouth has also adopted bylaws (described in Section 2.9.1) to protect residents from exposure to contaminated groundwater. If the Falmouth Board of Health allows the installation of a well above the FS-28 plume, within 500 feet crossgradient of the plume, or 1500 feet downgradient of the plume, AFCEE will sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over the FS-28 plume, within 500 feet crossgradient of the plume, or 1500 feet downgradient of the plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies. AFCEE will coordinate with the Falmouth Board of Health periodically (but not less than annually) to ensure the town knows of any changes to plume configurations or contaminant concentrations. Thus, the institutional controls presently in place adequately prevent residential exposure in all households surrounding the FS-28 plume.

Long-term monitoring of the site will continue to assess: (1) potential risks to the CWSW, (2) the migration of the small uncaptured portion of the plume, (3) the performance of the treatment system, (4) the quality of irrigation water and surface water near the plume, and (5) potential ecological impacts due to the operation of the treatment system. The monitoring program for FS-28 has been modified several times during the past four years and is expected to continue evolving as more is learned about the system performance. Monthly influent, intermediate (between the carbon beds), and effluent sampling for EDB analysis will still be required. Every five years a thorough site review will be conducted until contaminant concentrations are below regulatory standards. Operations, maintenance, monitoring, and reporting will continue until the three-step process outlined in Section 2.8.4 has been satisfied.

2.9.1 Institutional Controls

Several institutional controls protect area residents from exposure to FS-28 and FS-29 plume contaminants. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Additionally, the drilling of a new drinking water supply well within the CWMA would require the approval of the Massachusetts Legislature. In addition to the steps AFCEE has already taken to connect potentially affected residents to the municipal water supply, the town of Falmouth has also adopted bylaws to protect residents from exposure to contaminated groundwater. Thus, the institutional controls presently in place adequately prevent residential exposure in all Falmouth households surrounding the FS-28 and FS-29 plumes.

At its September 13, 1999 meeting, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. The Town of Falmouth will be responsible for implementing and enforcing these institutional controls on private wells within the town. These regulations require a permit from the Board of Health for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. Along with other requirements, this regulation states that “A Drinking Water Well must [be] tested for ... volatile organic compounds and found to be within potable water limits as defined in 310 CMR 22.000 Drinking Water Regulations

and must not exceed the Commonwealth of Massachusetts' maximum contaminant levels." AFCEE will coordinate with the Falmouth Board of Health periodically (but not less than annually) to ensure the town knows of any changes to plume configurations or contaminant concentrations.

If the Board of Health allows the installation of a well above a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume, AFCEE will sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies.

2.8.4 Steps to Achieving Remedial Action Objectives

MMR groundwater plumes, including the FS-28 and FS-29 plumes, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected, it will undertake a three-step process in achieving remedial action objectives. For active remedies for FS-28 and FS-29, this three-step process, which was outlined in the Proposed Plan dated February 2000 (AFCEE 2000c) will be implemented in the following manner:

- 1. **Remediate the aquifer to federal and state drinking water standards.** Restoration time frames and remedial costs estimated in this ROD were developed based on the expected time to attain federal and state drinking water standards (MCLs and MMCLs). During the period that remedial systems are in operation, AFCEE will monitor the plumes in accordance with the approved system performance monitoring plan. The plumes will be considered to have reached MCLs and MMCLs when there have been no detections exceeding those levels over a time period agreed to by AFCEE and EPA in consultation with DEP.*
- 2. **When MCLs and MMCLs are achieved and before the system is shut off, perform a risk assessment to determine if unacceptable ecological and/or human health risks are present; continue system operation and/or pursue additional measures as required to achieve acceptable risks.** AFCEE shall conduct a risk assessment*

once MCLs and MMCLs have been achieved (as defined in step 1, above) to determine whether the contaminants of concern remaining in the aquifer continue to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly between AFCEE and EPA in consultation with DEP and may result in aquifer cleanup that is more protective than the NCP point of departure risk level of (40 CFR Part 300.430(e)(2)), if justified, based on the following site-specific factors: “cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts” (NCP Preamble, page 8717).

3. **Once acceptable risks have been achieved, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.** AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:

A. *Technological - Not feasible if:*

- i. *The existing technologies or modifications cannot remediate to a level of no significant risk, or to levels which approach or achieve background; or*
- ii. *The reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
- iii. *The remedy does not or cannot be modified to meet other regulatory requirements.*

B. *Economic - The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels which approach or achieve background justifies related cost unless:*

- i. *The incremental cost for the remedy is substantial and disproportionate to the benefit of risk reduction, environmental restoration and monetary and non-monetary values; or cannot be adequately controlled.*
- ii. *The risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA, with input from DEP, have also agreed that if the implementation of steps two and or three above leads to a mutual decision to undertake additional cleanup and such decision results in a “significant” or “fundamental” change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an Explanation of Significant Differences (with public comment) or ROD Amendment, as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined jointly by

AFCEE and EPA, in consultation with DEP, in accordance with the criteria set forth in EPA's "A Guide to Preparing Superfund Proposed Plans, Records of Decision, And Other Remedy Selection Decision Documents," OSWER 9200.1-23P (1 999). In this manner, such changes will be subject to regulatory review and stakeholder involvement through issuance of a new proposed plan and/or a public comment period. If a dispute arises regarding any of the determinations to be jointly reached under the three-step process outlined above, such dispute shall be resolved under the dispute resolution procedures of the MMR FFA. This three-step process has been agreed to solely for groundwater cleanup at MMR due to unique circumstances presented by the location of the MMR plumes within the sole-source aquifer on Upper Cape Cod.

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.12 FUEL SPILL-29

A description of the selected remedy for the Fuel Spill-29 (FS-29) plume as specified in the FS-29 ROD (AFCEE 2000a) is as follows (in italics):

2.11 SELECTED REMEDIES

Alternative 3 is the selected remedy for the FS-29 plume. The proposed actions will capture the FS-29 plume through axial extraction at the distal portion of the plume preventing any potential discharge to surface water bodies or human exposure to contaminated groundwater through private or municipal wells. The selected remedy will remediate the FS-29 plume before it can spread further and before remediation becomes more difficult. The current understanding of the FS-29 plume is based on a relatively limited data set. Therefore, the remedy also includes significant additional site characterization and modeling to better understand the effectiveness of the selected remedy. If the additional data collection and modeling indicates that the selected remedy (Alternative 3) is not appropriate, new alternatives may be reviewed, with public involvement, to identify an alternate remedy that provides the best balance of trade-offs among the nine CERCLA criteria.

2.11.2 Selected Remedy for the FS-29 Plume

The selected remedy for the FS-29 plume is Alternative 3. This remedy includes design, construction, and operation of an extraction, treatment, and infiltration system to hydraulically capture and treat plume contaminants. The available data in and around the FS-29 plume is limited. Therefore, to support remedial design and to better understand the site physical and chemical characteristics, additional sampling and analysis will be conducted. This remedy also includes institutional controls, long-term monitoring of the plume, performance monitoring and evaluation of the treatment system, and ecological sampling to monitor the impacts of the system on the environment.

The selected remedy will remove, treat, and replace approximately 600 gallons per minute of groundwater. Contaminated groundwater will be removed through approximately two extraction wells located along the plume axis in the downgradient (western) portion of the plume, and treated water would be discharged to an infiltration gallery. Groundwater modeling indicates that the most upgradient portion of the FS-29 plume will be captured and treated by the system planned for the CS-21 plume.

The location of both extraction wells and the infiltration gallery will fall within the Ballymeade residential housing development. The nearest potentially acceptable location for a treatment plant would be east of Route 28 and west of the nearby residential area. This would require approximately 4000 feet of extraction well pipeline and approximately 4200 feet of reinjection well piping. An estimated 500-foot long access road would be required.

The expected influent concentrations for the FS-29 system (Table 2-18) were based on samples taken in the vicinity of the proposed extraction well locations. The high iron and manganese present in these locations suggest that pretreatment may be necessary upstream of the carbon filters. The need for pretreatment will be reviewed during the design phase. If the pretreatment requirement is still questionable at that point, the system will be constructed without pretreatment. A pretreatment system would be installed at a later date, only if it proves to be an operational necessity or if it appears to reduce life cycle costs.

As part of the detailed design of this extraction, treatment, and infiltration system, additional data will be needed. In comparison to the other MMR plumes, little is known about the FS-29 plume since it was the last plume discovered during the SWOU RI. The pre-design FS-29 field investigation will be conducted to better understand aquifer properties in and around the plume and to better define the distribution of EDB and CCl₄ within the plume. After the pre-design investigation, groundwater modeling will be conducted to confirm that extraction, treatment, and infiltration for plume capture is still considered effective as a plume remedy. If the additional site characterization and modeling indicate that the selected remedy (Alternative 3) is not appropriate, AFCEE

and EPA will review and select, with DEP concurrence and public involvement, an alternate remedy that provides that best balance of trade-offs among the nine CERCLA criteria (The alternate remedy would have to comply with the threshold criteria and provide the best balance of tradeoffs among the remaining seven CERCLA criteria.). Because of the close hydraulic and physical connection between the CS-21 and FS-29 plumes, the final design of remedial systems for both plumes should be completed at the same time. For this reason, the pre-design field investigation for the FS-29 plume will begin concurrently with the pre-design field investigations for the CS-4, CS-20, and CS-21 plumes.

Once the system is designed, a sampling and analysis plan, a performance monitoring evaluation plan, and an ecological sampling plan will be prepared. The long-term monitoring program will consist of sampling and analysis at monitoring wells within the body of the plume, downgradient of the plume and to either side of the plume. Operational monitoring will require monthly sampling of influent, effluent, and water collected between carbon vessels. Additionally, samples will be collected from each extraction well approximately twice each year. All samples will be analyzed for EDB and VOCs. As long as plume contaminants remain above statutory standards, a thorough site review will be conducted every five years.

Several institutional controls protect area residents from exposure to the FS-29 plume. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Although all of the residences overlying or close to the FS-29 plume are connected to the municipal water supply, additional protection is provided by the bylaws adopted by the town of Falmouth (described in Section 2.9.1) that protect residents from exposure to contaminated groundwater. If the Falmouth Board of Health allows the installation of a well above the FS-29 plume, within 500 feet crossgradient of the plume, or 1500 feet downgradient of the plume, AFCEE will sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over the FS-29 plume, within 500 feet crossgradient of the plume, or 1500 feet downgradient of the plume for which

public water connections have not been provided. The frequency of residential well sampling will' be determined in consultation with AFCEE, health authorities, and the regulatory agencies. AFCEE will coordinate with the Falmouth Board of Health periodically (but not less than annually) to ensure the town knows of any changes to plume configurations or contaminant concentrations. Thus, the institutional controls presently in place adequately prevent residential exposure in all households surrounding the FS-29 plume.

2.9.1 Institutional Controls

Several institutional controls protect area residents from exposure to FS-28 and FS-29 plume contaminants. The safety of all public water supplies within Massachusetts is currently regulated by the Commonwealth. Additionally, the drilling of a new drinking water supply well within the CWMA would require the approval of the Massachusetts Legislature. In addition to the steps AFCEE has already taken to connect potentially affected residents to the municipal water supply, the town of Falmouth has also adopted bylaws to protect residents from exposure to contaminated groundwater. Thus, the institutional controls presently in place adequately prevent residential exposure in all Falmouth households surrounding the FS-28 and FS-29 plumes.

At its September 13, 1999 meeting, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. The Town of Falmouth will be responsible for implementing and enforcing these institutional controls on private wells within the town. These regulations require a permit from the Board of Health for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. Along with other requirements, this regulation states that "A Drinking Water Well must [be] tested for ... volatile organic compounds and found to be within potable water limits as defined in 310 CMR 22.000 Drinking Water Regulations and must not exceed the Commonwealth of Massachusetts' maximum contaminant levels." AFCEE will coordinate with the Falmouth Board of Health periodically (but not less than annually) to ensure the town knows of any changes to plume configurations or contaminant concentrations.

If the Board of Health allows the installation of a well above a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume, AFCEE will sample this well regularly. Furthermore, AFCEE will regularly sample private wells installed prior to the promulgation of the Board of Health regulations that are over a plume, within 500 feet crossgradient of a plume, or 1500 feet downgradient of a plume for which public water connections have not been provided. The frequency of residential well sampling will be determined in consultation with AFCEE, health authorities, and the regulatory agencies.

2.8.4 Steps to Achieving Remedial Action Objectives

MMR groundwater plumes, including the FS-28 and FS-29 plumes, are located within the Cape Cod sole-source aquifer. Therefore, AFCEE has agreed that for all active remedies selected, it will undertake a three-step process in achieving remedial action objectives. For active remedies for FS-28 and FS-29, this three-step process, which was outlined in the Proposed Plan dated February 2000 (AFCEE 2000c) will be implemented in the following manner:

- 1. Remediate the aquifer to federal and state drinking water standards.** *Restoration time frames and remedial costs estimated in this ROD were developed based on the expected time to attain federal and state drinking water standards (MCLs and MMCLs). During the period that remedial systems are in operation, AFCEE will monitor the plumes in accordance with the approved system performance monitoring plan. The plumes will be considered to have reached MCLs and MMCLs when there have been no detections exceeding those levels over a time period agreed to by AFCEE and EPA in consultation with DEP.*
- 2. When MCLs and MMCLs are achieved and before the system is shut off, perform a risk assessment to determine if unacceptable ecological and/or human health risks are present; continue system operation and/or pursue additional measures as required to achieve acceptable risks.** *AFCEE shall conduct a risk assessment once MCLs and MMCLs have been achieved (as defined in step 1, above) to determine whether the contaminants of concern remaining in the aquifer continue to pose unacceptable ecological and/or human health risks. This risk determination shall be made jointly between AFCEE and EPA in consultation with DEP and may result in aquifer cleanup that is more protective than the NCP point of departure risk level of (40 CFR Part 300.430(e)(2)), if justified, based on the following site-*

specific factors: “cumulative effects of multiple contaminants, the potential for exposure from other pathways of exposure at the site, population sensitivities, potential impacts on environmental receptors, and cross-media impacts” (NCP Preamble, page 8717).

3. ***Once acceptable risks have been achieved, evaluate the technical and economic feasibility of additional remediation to approach or achieve background concentrations.*** *AFCEE shall proceed with a technical and economic feasibility analysis of approaching or achieving background concentrations in the aquifer. The feasibility of approaching or achieving background will be determined in accordance with the following criteria:*
 - a. *Technological - Not feasible if:*
 - i. *The existing technologies or modifications cannot remediate to a level of no significant risk, or to levels which approach or achieve background; or*
 - ii. *The reliability of the identified alternative has not been sufficiently proven and a substantial uncertainty exists as to whether it will effectively reduce risk; or*
 - iii. *The remedy does not or cannot be modified to meet other regulatory requirements.*
 - b. *Economic - The benefits of implementing a remedy and reducing the concentrations of contaminants in the environment to levels which approach or achieve background justifies related cost unless:*
 - i. *The incremental cost for the remedy is substantial and disproportionate to the benefit of risk reduction, environmental restoration and monetary and non-monetary values; or cannot be adequately controlled.*
 - ii. *The risk of harm to health/safety/public welfare/environment by the remedy cannot be adequately controlled.*

AFCEE and EPA, with input from DEP, have also agreed that if the implementation of steps two and or three above leads to a mutual decision to undertake additional cleanup and such decision results in a “significant” or “fundamental” change to the remedial approach, cleanup levels, and/or costs documented in this final ROD, AFCEE will execute an Explanation of Significant Differences (with public comment) or ROD Amendment, as appropriate. Whether any such additional cleanup actions result in a significant or fundamental change to this final ROD shall be determined jointly by AFCEE and EPA, in consultation with DEP, in accordance with the criteria set forth in EPA’s “A Guide to Preparing Superfund Proposed Plans, Records of Decision, And

Other Remedy Selection Decision Documents,” OSWER 9200.1-23P (1 999). In this manner, such changes will be subject to regulatory review and stakeholder involvement through issuance of a new proposed plan and/or a public comment period. If a dispute arises regarding any of the determinations to be jointly reached under the three-step process outlined above, such dispute shall be resolved under the dispute resolution procedures of the MMR FFA. This three-step process has been agreed to solely for groundwater cleanup at MMR due to unique circumstances presented by the location of the MMR plumes within the sole-source aquifer on Upper Cape Cod.

An ESD was prepared in 2008 (AFCEE 2008) to document changes of certain components of the remedies listed in the RODs for the CS-4, CS-20, CS-21, FS-13, FS-28, and FS-29 groundwater plumes. This ESD changed some of the design considerations of the remedial systems associated with those sites, and also updated the language of the RODs to include the three-step process (described in detail in Section 3.1.4) and to expand the LUCs (as described in Section 3.1.2).

A.13 LANDFILL-1

A description of the selected remedy for the Landfill-1 (LF-1) plume as specified in the LF-1 ROD (AFCEE 2007a) is as follows (in italics):

2.13 SELECTED REMEDY FOR THE LF-1 GROUNDWATER OPERABLE UNIT

Based on the Administrative Record for the LF-1 site and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 5 as the remedy for the LF-1 groundwater OU.

2.13.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 5, which consists of continued operation of the current LF-1 treatment system and the LF-1 SPEIM program, the installation of one additional extraction well (27EW0006) south of 27EW0002 to increase capture of the southern portion of the LF-1 plume, LUCs, and the Bourne Water Provision. The water from the additional extraction well will be pumped to the Hunter Avenue Treatment Facility for treatment and infiltration/reinjection. The selected remedy is protective of human health through implementation of LUCs, complies with ARARs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame and is cost-effective.

2.13.2 Detailed Description of Selected Remedy

The selected remedy is Alternative 5, which consists of the existing LF-1 ETI system (five extraction wells and an associated infiltration trench) with the system expanded to the south (one extraction well, 27EW0006) (Figure 2-4) to improve capture of the plume in that area. A portion of the treatment plant effluent is to be diverted seasonally (April through October) away from the infiltration gallery to be used for irrigation purposes by Veterans Affairs at the Massachusetts National Cemetery. The additional flow from

27EW0006 is treated at the Hunter Avenue Treatment Facility and infiltrated at two new galleries located close to the Hunter Avenue Treatment Facility.

The ETI system consists of ETI of groundwater following federal and state standards for PCE, TCE, CCl₄, 1,4-dichlorobenzene, vinyl chloride, and 1,1,2,2-TeCA as stipulated in the current O&M plan. The alternative has the flexibility of modifying the treatment system to optimize the cleanup time frame and to insure it continues to meet performance objectives. Most likely, modifications would be executed with the existing extraction wells and infiltration trenches and galleries, and could involve the use of packers to reduce the effective vertical extent of the extraction screen, or adjusting flow rates. However, the alternative does not exclude the possibility of adding additional system components, if deemed necessary. Modifications would be made for the purpose of improving treatment system operation, expediting the plume cleanup, and maintaining containment of the plume upgradient of a point approximately 800 feet west of the base boundary.

After the FS was conducted the LF-1 groundwater model and plume shells were revised. The groundwater model predictions with the revised model and plume shells are improved over what was prepared for the LF-1 FS because the more recent model predictions more accurately reflect the current and future groundwater flow patterns. In early 2006 the LF-1 Alternative 5 performance objective language was developed based on review of these updated modeling animations. A summary of the modeling and development of the performance objectives are presented in a Project Note: LF-1 Alternative 5 Performance Objectives (Jacobs 2007).

The LF-1 six-well ETI system's (Alternative 5) performance objective is to provide for containment of the groundwater plume upgradient of a point approximately 800 feet west of the base boundary and to achieve cleanup levels for COCs in the portion of the plume downgradient from the same point through the natural attenuation processes of dilution and dispersion. Achievement of this objective will be measured by the following three metrics:

1. *The LF-1 plume is expected to separate at a point approximately 800 feet downgradient of the base boundary by approximately 2013.*
2. *The LF-1 groundwater between a point approximately 800 feet downgradient of the base boundary and Route 28 is expected to be below cleanup levels for plume COCs by approximately 2023.*
3. *All LF-1 groundwater downgradient of the extraction wells is expected to be below cleanup levels for plume COCs by approximately 2027.*

In order to measure achievement of these metrics, the Air Force will use a combination of monitoring wells and groundwater modeling. If the ETI system does not meet its performance objective, the Air Force, with concurrence with the regulatory agencies, will evaluate and make, as necessary, system improvements.

As part of the remedy, a groundwater monitoring plan, based on EPA guidance and subject to regulatory agency approval, will be developed and made a part of the existing Comprehensive Long-Term Monitoring Plan. The groundwater monitoring plan will specify how AFCEE will monitor the plume downgradient of the extraction wells (i.e., off-base property) using the technique of monitored natural attenuation.

This alternative would provide for chemical and hydraulic monitoring of the plume, as long as active remediation continues, and chemical monitoring of the plume until the RAOs are met. Chemical monitoring of the limited extent of perchlorate will also be conducted. Monitoring data would aid in ongoing optimization and could prompt additional action if COC concentrations did not decrease as expected. Monitoring results will be periodically reported in formal reports. CERCLA reviews would be performed every five years throughout the lifetime of the alternative. A residual risk assessment and/or an evaluation of the technical and economic feasibility of additional remediation to approach background concentrations would be performed if deemed necessary. The selected remedy also includes implementation of LUCs, and the Bourne water provision. Further discussion of the LUCs is provided in Section 2.11.2 of this report.

Excerpt from Section 2.11.2 addressing LUCs:

The following text describes the LUCs that will be implemented for both the LF-1 source area selected remedy and the LF-1 groundwater selected remedy discussed in Section 2.13 of this report. Exposure to the waste beneath the LF-1 landfill cover system could pose an unacceptable risk to human health. The LF-1 contaminated groundwater currently poses an unacceptable risk to human health if used for household purposes (i.e., ingestion, dermal contact, and inhalation of vapors released during household use of water).

The LF-1 source area is located in the middle of the cantonment area. The LF-1 contaminated groundwater is located in the western part of the MMR cantonment area, and a portion of the contaminated groundwater has migrated past the MMR boundary into the neighboring towns of Bourne and Falmouth. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as “LUCs,” must be established for the LF-1 source area and groundwater to avoid the risk of exposure to the LF-1 source area and LF-1 groundwater. These LUCs are needed both on-base and off-base, within the towns of Bourne and Falmouth, until the LF-1 source area and contaminated groundwater no longer poses an unacceptable risk.

The performance objectives of the LUCs are to

- Prevent access to waste and soils beneath the LF-1 cover system until the waste and soils no longer pose an unacceptable risk,*
- Prevent or reduce access to or use of the groundwater from the LF-1 contaminated groundwater until the groundwater no longer poses an unacceptable risk, and*
- Maintain the integrity of the current or future remedial or monitoring system such as the landfill cover system, the treatment systems, and monitoring wells.*

The LUCs will encompass the area including the LF-1 source area and contaminated groundwater and surrounding areas to reduce the risk from exposure to contaminated groundwater (Figure 2-11). The on-base area of concern is controlled and operated by

the USCG and the Air Force, who lease this land from the Commonwealth of Massachusetts. It is expected that these entities (USCG and U.S. Air Force) will control the area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as the Air Force fulfills its responsibility to establish, monitor, maintain, and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of COCs in the groundwater are at such levels as to allow unrestricted use and exposure and the landfill waste and soils no longer pose an unacceptable risk, or (2) the Air Force, with the prior approval of the EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following three LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. The Commonwealth of Massachusetts only has enforcement authority regarding the third LUC. In the event that the Town of Bourne fails to promptly enforce the first LUC and/or the Town of Falmouth fails to promptly enforce the second LUC or the Commonwealth of Massachusetts fails to promptly enforce the third LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e., the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

- 1) On 24 September 2003, to better protect the public health and welfare of its citizens, the Bourne BOH, voted to amend the private well construction regulations originally adopted on 23 February 2000. The BOH will not approve construction of a well intended for human water consumption or irrigation if the well is known to be over a plume of contamination or in the direct path of an advancing plume of contamination. The Bourne BOH Well Regulations do not apply to use of existing drinking water wells and irrigation wells. The regulations are reproduced in Appendix C. To assist the Bourne BOH in the implementation*

of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the LF-1 contaminated groundwater within the town of Bourne. While Figure 2-11 shows the current area of LUCs in the town, the Bourne BOH may modify the areas subject to the moratorium, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-11.

- 2) The Falmouth BOH requires a permit for the installation and use of all wells, including drinking water wells, irrigation wells, and monitoring wells. If a permit to install a drinking water well is approved, the Falmouth BOH will not approve the use of that well until its water has been tested and the BOH has determined that the water is potable. The Falmouth BOH Water Well Regulations do not apply to use of existing drinking water wells and irrigation wells. The regulations, which are reproduced in Appendix D, cover documented and anticipated areas of contamination from the LF-1 plume. To assist the Town of Falmouth in the implementation of this LUC, the Air Force will meet with the BOH on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the LF-1 plume within the town of Falmouth. While Figure 2-11 shows the current area of LUCs in the town, the Falmouth BOH may modify the areas where well use is excluded, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-11.*
- 3) In addition to the towns of Bourne and Falmouth BOH regulations, which generally applies to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the LF-1 contaminated groundwater for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy. This LUC applies to both on-base and off-base portions of LF-1.*

The Air Force has provided municipal water supply hook-ups for all residences in areas of current or anticipated groundwater contamination. In conjunction with the Bourne BOH Well Regulations and the Falmouth BOH Water Well Regulations, the municipal water supply hook-ups significantly reduce the likelihood of exposure to contaminated groundwater from existing wells and from any future wells installed in areas of anticipated contamination. Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on, and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

- 1) *For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and USCG (major tenants at the MMR). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
- 2) *For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the USCG by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging or subsurface soil disturbance activity. All such permits are forwarded to the IRP for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).*
- 3) *The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the LF-1 source and groundwater areas and to protect monitoring wells and the treatment system's infrastructure. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The LF-1 source area and groundwater plume are encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a well, which has not been approved via the procedures above, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Bourne BOH or the Falmouth BOH, and the MassDEP in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or the treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of the LF-1 source area and plume. The extent of the Air Force's enforcement of this LUC does not address off-base parties failing to file a Dig Safe request nor Dig Safe improperly processing a notification, but if incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage cause by third parties to the remedial system infrastructure or monitoring wells.*

The LUCs are intended to prevent exposure to groundwater impacted by the LF-1 plume; however, to insure that the LUCs obtain the LUC performance objectives the Air Force will take the following action.

Within three years of the signing of the ROD, the Air Force shall:

- a. Document all private wells (i.e. non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the LF-1 plume.*
- b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the LF-1 plume, or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the EPA, until the plume no longer presents a threat to that well as determined in coordination with EPA.*
- c. If the Air Force identifies a well containing COCs, the Air Force shall assess the risk current and potential future non-drinking uses of such a well pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and approval.*
- d. If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate BOH. If the decommissioning is not accepted, the Air Force will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA approval, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the LF-1 plume having carcinogens in excess of ARARs (i.e., MCLs, non-zero MCLGs), and prevent exposure to groundwater from the LF-1 plume that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic hazard index greater than one.*

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (i) whether the use restrictions and controls referenced above were effectively communicated, (ii) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property, and (iii) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land changes that would be inconsistent with the LUC objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUC objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

The Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the LF-1 source area and the LF-1 groundwater area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

The Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the LF-1 source area and LF-1 plume area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs. The Air Force will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining LUCs which may affect LF-1.

A.14 STORM DRAIN-5

A description of the selected remedy for the Storm Drain-5 (SD-5) plume as specified in the SD-5 ROD (AFCEE 2006a) is as follows (in italics):

2.11 SELECTED REMEDY FOR THE SD-5 GROUNDWATER OPERABLE UNIT

Based on the Administrative Record for the SD-5 site and the evaluation of comments received by interested parties during the public comment period, AFCEE has selected Alternative 2 as the remedy for the SD-5 groundwater OU.

2.11.1 Summary of the Rationale for the Selected Remedy

The selected remedy is Alternative 2, which consists of LTM with LUCs. A full description of the preferred remedy is provided below. The selected remedy provides a means of verifying the natural attenuation of the groundwater contamination through monitoring, is protective of human health through implementation of LUCs, does not have any significant implementability concerns, and has minor impacts on worker safety, the community, and the environment. The preferred remedy was selected over the other alternatives because it is expected to achieve the RAOs in a reasonable time frame (three years) and is cost-effective.

2.11.2 Detailed Description of Selected Remedy

AFCEE has developed a monitoring plan for the SD-5 groundwater OU that will include data from a network of monitoring wells. The monitoring wells will be sampled periodically for VOCs. Periodic monitoring results will be reported in a letter report. Periodic evaluation of all analytical results will include tracking the natural attenuation of the SD-5 groundwater contamination. The monitoring plan itself will be reviewed annually for adequate coverage of the area and optimization. Monitoring will continue for two years beyond the time at which TCE concentrations decrease below the MCL. CERCLA five-year reviews will be performed to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use levels in

the groundwater. A residual risk assessment and/or an evaluation of the technical and economic feasibility of additional remediation to approach or achieve background concentrations would be conducted if deemed necessary.

The SD-5 contaminated groundwater currently poses an unacceptable risk to human health if used for drinking water purposes. The SD-5 contaminated groundwater is located in the central part of the MMR cantonment area, and a portion of the SD-5 contaminated groundwater has migrated past the MMR boundary into the neighboring town of Mashpee. Therefore, administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use, known as “land use controls” (LUCs), must be established for this area of concern to avoid the risk of exposure to groundwater from the SD-5 area. These LUCs are needed both on-base and off-base, within the town of Mashpee, until the groundwater from the SD-5 contaminated groundwater no longer poses an unacceptable risk.

The performance objectives of the LUCs are:

- Prevent access to or use of the groundwater from the SD-5 contaminated groundwater until the groundwater no longer poses an unacceptable risk;*
- Maintain the integrity of the current or future remedial or monitoring system such as treatment systems and monitoring wells.*

The LUCs will encompass the area including the SD-5 contaminated groundwater (Figure 2-12) and surrounding areas to prevent a risk from exposure to contaminated groundwater. The on-base area of concern is controlled and operated by the U.S. Air Force, which leases this land from the Commonwealth of Massachusetts. It is expected that these entities will operate and own, respectively, the area of concern and the surrounding area for the duration of this ROD. As a result, the Air Force will coordinate with the Commonwealth of Massachusetts as it fulfills its responsibility to establish, monitor, maintain and report on the LUCs for this site.

Each LUC will be maintained until either (1) the concentrations of TCE in the groundwater are at such a level to allow unrestricted use and exposure, or (2) the Air

Force, with the prior approval of EPA and MassDEP, modifies or terminates the LUC in question.

The Air Force is responsible for ensuring that the following two LUCs are established, monitored, maintained, and reported on as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of the final remedy selected in this ROD. In the event that the Town of Mashpee fails to promptly enforce the first LUC or the Commonwealth of Massachusetts fails to promptly enforce the second LUC, the Air Force will act in accordance with the third to last paragraph in this section. For purposes of the preceding sentence, “promptly enforce” means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency’s (i.e. the Town or the Commonwealth) discovery of the violation or potential violation; otherwise, enforce as soon as possible.

- 1) To better protect the public health and welfare of its citizens, the Mashpee Board of Health, adopted a moratorium on private drinking water wells on April 23, 1998, amended July 29, 1999, in the town of Mashpee. The moratorium, as amended, applies to existing wells and potential future wells, and restricts any and all uses of groundwater. The areas where well use is excluded are defined by the Mashpee Board of Health, and include documented areas of contamination and anticipated areas of contamination from the SD-5 contaminated groundwater. To assist the Mashpee Board of Health in the implementation of this LUC, the Air Force will meet with the Board of Health on an annual basis, or more frequently if needed, to provide and discuss plume maps that document the current and projected location of the SD-5 contaminated groundwater within the town of Mashpee. While Figure 2-12 shows the current area of LUCs in the town, the Mashpee Board of Health may modify the areas where well use is excluded, and this LUC will apply to such areas even if they differ from the area shown in Figure 2-12.*
- 2) In addition to the Board of Health regulation, which generally applies to small water supply wells, existing LUCs also prevent the possible creation of a large potable water supply well. The MassDEP administers a permitting process for any new drinking water supply wells in Massachusetts that propose to service more than 25 customers or exceed a withdrawal rate of 100,000 gallons per day. This permitting process, which serves to regulate the use of the SD-5 contaminated groundwater for any withdrawals of groundwater for drinking water purposes, constitutes an additional LUC for this final remedy. This LUC applies to both on-base and off-base portions of SD-5.*

Additionally, the Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, reported on and enforced as part of this final remedy to ensure protection of human health and the environment in accordance with CERCLA and the NCP for the duration of this final remedy selected in this ROD.

- 1) For the on-base area of concern, a prohibition on new drinking water wells serving 25 or fewer customers has been established and placed on file with the planning and facilities offices for the Massachusetts Air and Army National Guard and United States Coast Guard (major tenants at the Massachusetts Military Reservation). The prohibition will be applied to future land use planning per Air National Guard Instruction (ANGI) 32-1003, Facilities Board, Army National Guard Regulation 210-20, Real Property Development Planning for the Army National Guard, and Commandant Instruction Manual 11010.14, Shore Facility Project Development Manual.*
- 2) For the on-base area of concern, the Air National Guard has administrative processes and procedures that require approval for all projects involving construction or digging/subsurface soil disturbance, currently set forth in ANGI 32-1001, Operations Management. This procedure is a requirement of the Army National Guard and the United States Coast Guard by the Air National Guard through Installation Support Agreements. The Air National Guard requires a completed AF Form 103, Base Civil Engineer Work Clearance Request (also known as the base digging permit), prior to allowing any construction, digging or subsurface soil disturbance activity. All such permits are forwarded to the Installation Restoration Program for concurrence before issuance. An AF Form 103 will not be processed without a Dig Safe permit number (see next paragraph).*
- 3) The Dig Safe program implemented in Massachusetts provides an added layer of protection to prevent the installation of water supply wells in the SD-5 area and to protect monitoring wells and the treatment system's infrastructure. This program requires, by law, anyone conducting digging activities (e.g., well drilling) to request clearance through the Dig Safe network. The Air Force at the MMR is a member utility of Dig Safe. The SD-5 contaminated groundwater is encompassed by a geographical area identified by the Air Force as a notification region within the Dig Safe program. Through the Dig Safe process, the Air Force will be electronically notified at least 72 hours prior to any digging within this area. The notification will include the name of the party contemplating, and the nature of, the digging activity. The Air Force will review each notification and if the digging activity is intended to provide a previously unknown water supply well, the Air Force will immediately notify the project sponsor (of the well drilling), the EPA, the Mashpee Board of Health and the MassDEP, in order to curtail the digging activity. If the Dig Safe notification indicates proposed work near monitoring wells or treatment system infrastructure, the Air Force will mark its components to prevent damage due to excavation. This LUC applies to both on-base and off-base portions of SD-5. The extent of the Air Force's enforcement of this LUC does not address off-base parties*

failing to file a dig Safe request nor Dig Safe improperly processing a notification, but if such incidents do occur, the Air Force is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the remedial system infrastructure or monitoring wells.

Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the EPA and MassDEP for informational purposes. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the LUCs and how any LUC deficiencies or inconsistent uses have been addressed. The annual evaluation will address (i) whether the use restrictions and controls referenced above were effectively communicated, (ii) whether the operator, owner and state and local agencies were notified of the use restrictions and controls affecting the property, and (iii) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

The Air Force shall notify the EPA and MassDEP 45 days in advance of any proposed land use changes that would be inconsistent with the LUC objectives or the final remedy. If the Air Force discovers a proposed or ongoing activity that would be or is inconsistent with the LUC objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the LUCs, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Air Force becomes aware of this breach. The Air Force will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the LUC objectives or use restrictions, or any other action that may interfere with the effectiveness of the LUCs. The Air Force will notify the EPA and MassDEP regarding how the Air Force has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

The Air Force will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the SD-5 area so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the Air Force to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Air Force will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to LUCs.

Respecting use restrictions and LUCs identified and selected for this ROD, the Air Force shall not modify or terminate LUCs, implementation actions, or modify land use without approval by the EPA and MassDEP. The Air Force, in coordination with other agencies using or controlling the SD-5 area, shall seek prior concurrence before taking any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs.

APPENDIX B

MassDEP Concurrence Letter



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

June 30, 2011

Mr. James T. Owens III, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency,
New England Office
One Congress Street, Suite 1100
Boston, MA 02114-2023

RE: **BOURNE**
Release Tracking Number: 4-0000037
Massachusetts Military Reservation (MMR)
**Explanation of Significant Differences for the
Installation Restoration Program
Groundwater Plumes at the Massachusetts
Military Reservation, Concurrence**

Dear Mr. Owens;

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the document entitled *Explanation of Significant Differences for the Installation Restoration Program Groundwater Plumes at the Massachusetts Military Reservation* (the ESD), dated April 2011. The ESD was prepared by the Air Force Center for Engineering and the Environment (AFCEE) at the Massachusetts Military Reservation (MMR) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to document changes to the language in the Records of Decision (RODs) for the following Installation Restoration Program (IRP) Sites: Ashumet Valley, Chemical Spill (CS)-4, CS-10, CS-19, CS-20, CS-21, CS-23, Fuel Spill (FS)-1, FS-12, FS-13, FS-28, FS-29, Landfill (LF)-1, and Storm Drain (SD)-5 (the Sites). Contaminated groundwater associated with the MMR is a component at each of the Sites.

The RODs that prescribe the final remedies for the above referenced Sites were developed over an approximate 10-year period. During that time, refinements and revisions were made to the language used in RODs at the MMR based on discussions and negotiations with MassDEP, EPA, AFCEE and other stakeholders. The refinements provide greater consistency and clarity to the remedies described in the RODs. The intent of the ESD is to apply these refinements to all potentially affected RODs. While at least one of the changes summarized below will apply to each of the RODs, not all of the changes will apply to every ROD. In general, the ROD changes can be placed into four categories:

1. Revisions to the phrasing of Remedial Action Objectives (RAOs);
2. Revisions to the phrasing of Land Use Controls (LUCs);

3. Clarifying the inclusion of Monitored Natural Attenuation (MNA) as a component of selected remedies; and
4. Adding and revising text regarding the MMR Three-Step Process for each site which describes the anticipated steps that will need to be completed to achieve site closure.

In regards to the MNA revision referenced above, MassDEP notes that for any remedy to be considered MNA, the remedy must be designed and implemented following the guidelines outlined in the U.S. EPA OSWER Directive 9200.4-17P, April 21, 1999 entitled "*Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*" ("the OSWER Directive"). The OSWER Directive is MassDEP's primary reference for MNA remedies. While various attenuation processes are known to occur under certain conditions, the OSWER Directive "prefers those processes that degrade or destroy contaminants". The Massachusetts Contingency Plan, 310 CMR 40.0000 (MCP) requires the consideration of "technologies which reuse, recycle, destroy, detoxify or treat oil and/or hazardous materials" as well as "remedial actions to reduce the overall mass and volume of oil and/or hazardous materials". Accordingly, the MCP and the OSWER Directive require specific documentation to demonstrate that degradation or destruction of contaminants is the primary attenuation process. If the OSWER guidelines for MNA documentation are not followed, or if it is demonstrated that dispersion (i.e. the dilution of contaminated groundwater by mixing with unaffected groundwater) and not degradation or destruction is the primary natural attenuation process in the aquifer for any of the IRP groundwater plumes at the MMR, MassDEP will consider *Long-Term Monitoring* to be a component of the selected remedies, rather than MNA. The distinction between MNA and Long Term Monitoring does not affect MassDEP's concurrence.

MassDEP concurs with the ESD. The final remedies for the IRP groundwater plumes ensure a sufficient and protective level of control such that none of the contamination associated with the IRP groundwater plumes will present a significant risk of harm to health, safety, public welfare or the environment during any foreseeable period of time. Moreover, the remedies have been designed to reduce the level of contaminants to background levels, consistent with the MCP.

MassDEP's concurrence with the ESD is based upon representations made to MassDEP by the AFCEE and assumes that all information provided is substantially complete and accurate. Without limitation, if MassDEP determines that any material omissions or misstatements exist, if new information becomes available, if LUCs are not properly implemented, monitored and/or maintained or if conditions within any of the IRP groundwater plumes change, resulting in potential or actual human exposure or threats to the environment, MassDEP reserves its authority under M.G.L. c. 21E, CERCLA, the MCP, the NCP and any other applicable law or regulation to require further response actions at the Sites including, without limitation, additional investigation, remedial measures, and the implementation of LUCs. MassDEP will review relevant information as it becomes available to determine if additional investigative and/or remedial measures are necessary for the protection of public health, safety, welfare or the environment at the Sites. This includes, without limitation, new regulatory requirements or changes in the environmental conditions at the Sites.

Please incorporate this letter into the Administrative Record for the IRP groundwater plumes. If you have any questions regarding this matter, please contact Leonard J. Pinaud, Chief, State & Federal Site Management Section, at (508) 946-2871 or Millie Garcia-Serrano, Deputy Regional Director of the Bureau of Waste Site Cleanup at (508) 946-2727.

Sincerely,

A handwritten signature in black ink, appearing to read "Paul Locke". The signature is fluid and cursive, with a large initial "P" and "L".

Paul Locke, Acting Assistant Commissioner
Massachusetts Department of Environmental
Protection

L/LP/PWL

4-0000037 IRP ESD Letter 06-2011

ec: David Johnston, Acting Regional Director
Millie Garcia-Serrano, Deputy Regional Director
Leonard J. Pinaud, Chief, State & Federal Site Management
Rebecca Tobin, Regional Counsel
MassDEP Southeast Region
MMR Senior Management Board
MMR Plume Cleanup Team
Upper Cape Boards of Selectmen
Upper Cape Boards of Health